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Volume 52
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Photo courtesy Harvester World

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Journal of Forestry

Official Organ of the Society of American Foresters

The Significance of Weather Modification to a Forester[1]

A. A. Brown
Chief, Division of Forest Fire Research,
U. S. Forest Service, Washington, D. C.

IN THE PROGRESS of science over the last 100 years, one generalization might be made—most progress has been made in our knowledge of the land, less in our knowledge of the sea, and least of all of the atmosphere around and above us. Some call the last fifty years the air age. We think nothing of travelling from coast to coast by plane. There are many here who have been half way around the world and back, or even around the world. Sixty miles is now only a hop horizontally, but sixty miles vertically—that is a different matter! Sixty miles above the earth's surface or even six miles above, we enter a strange and mostly unexplored atmosphere. Air transportation as a medium of travel and the possibility of jet travel in the stratosphere have focused the attention of scientists on the many unknowns in this environment out of increasing distances and on the great supposed void beyond the earth's gravity called "space." New knowledge is developing rapidly. Many of us will see it reflected in a few years not just in the "space man" comics but in our children's school books.

Why should a forester be concerned about the atmosphere, especially the upper atmosphere? There are some practical reasons, some of which have been presented by J. S. Barrows in his article[2] describing the participation of our Fire Research group in a pioneering project with the Munitalp Research Foundation and the Weather Bureau that will give us a new understanding of the evolution and behavior of fire-setting lightning storms. The need for such knowledge was recognized by foresters 30 years ago. Many administrative studies were conducted to track lightning storms and to define the areas in which they concentrate. Such studies were worth while and much has been learned. But there were too many gaps in basic knowledge of the physical relationships for either the physicist or the meteorologist to help us much in interpreting observations. Now some of these gaps are becoming closed and at last we have a chance to remove the mystery and to deal more effectively with the phenomena of dry lightning storms and lightning fires.

The importance of lightning storms in the West is only one aspect of the pattern of climate and weather with which we are all concerned. Practicing foresters are as dependent as the farmer on climate and weather for success in growing trees and forage. In fact, they are more at the mercy of the weather than the agriculturist, since the agriculturist has more opportunity to make artificial modifications of the micro-climate, particularly in terms of the moisture supply. There is no need to remind you that local and general weather conditions determine the success or failure of both natural and artificial seeding of trees and forage plants, and the success of planting. Weather conditions determine rates of growth and species adaptation. They determine liabilities from floods, blow down, ice breakage, frost, and drought. They set time limits and schedules to all kinds of forest operations and uses.

In research nearly all field experiments must take into account weather variations as one of the controlling variables. In forest fire research we are particularly conscious of weather factors because both the liability to fires starting and the behavior and spread of fires are directly controlled by weather elements. Much of the progress in forest fire control can be credited to the studies of weather-fire relationships as shown by the contributions of Harry T. Gisborne, our late pioneer and explorer in the fire-weather field. The fire danger rating systems and the development and use of fire-weather forecasts were natural results of such research. Both are still imperfect, but the daily dependence placed on them by fire agencies is convincing evidence of their importance to fire control.

Harry Gisborne felt, as I do now, that we were just on the verge of new discoveries and developments in weather science, of importance to fire control that would dwarf everything that had gone before. He had two reasons. One was that a very important weather factor had been left out in the measurement and prediction of fire behavior—the degree of local atmospheric stability in the vicinity of a going fire. The second reason was the new knowledge developing on cloud formation and dissipation. This offered a vista of things to come, where we might prevent lightning fires and perhaps exercise to some degree other desired forms of local weather modification. It is still too early to predict exactly how important new knowledge in these fields will help the forester in 1960, but the

[1]Presented at the annual meeting, Society of American Foresters, Colorado Springs, Colo., September 1953.

[2]Barrows, J. S. Lightning fire research in the Rocky Mountains. Jour. Forestry, 52:845-847. 1954.

prospects are promising. Progress has been made in relating instability of the air to fire behavior. The article[3] by R. Keith Arnold and C. C. Buck gives you some of the things we have learned from recent research. George Byram of the Southeastern Station is making an intensive study of the kinds of local air turbulence that cause dangerous fire behavior, and the Weather Bureau is cooperating closely in an effort to identify criteria that can be used to forecast such situations. Progress in weather modification through cloud seeding is already a long and involved story, even though its history goes back only to 1946. Both popular and technical literature on this subject is available from many sources.

I shall confine the remainder of my comments to a nontechnical summary of some of the factors that will continue to make developments in this field of interest and potential importance to the forester.

The melting point of ice is 0° Centigrade or 32° Fahrenheit, but this is not necessarily the freezing point of water or water vapor. As a consequence, water vapor in the air may, and often does, remain in liquid form in a supercooled state. This has importance because precipitation in our middle latitudes, the temperate zone, is assumed to start with the formation and growth of ice crystals to the point where they yield to gravity and fall from a cloud as rain or snow. Dr. Vincent Schaefer of General Electric discovered that this does not occur automatically until a critical temperature of —39° C. is reached. Between this point and 0° C. ice crystal formation depends on the presence of suitable nuclei on which such ice crystals can grow. The number of such nuclei varies enormously in nature. In studies he conducted there were less than 100 per cu. meter of air 50 percent of the time. But maximums of as high as ten million per cubic meter were recorded. So the variations were found to be in the order of a million. The best of natural nuclei are derived from clay, loess, volcanic ash, and salt particles. They become effective at temperatures of —12° to —15° C. Other common ones become effective at —20° to —30°.

In a supercooled cloud of water vapor, dry ice pellets immediately produce a myriad of ice crystals because the dry ice temperature of —78° C. cools the water droplets quickly below their critical temperature of —39°. This produces an abundance of natural ice nuclei even though the exposure is only for a fraction of a second. One of Schaefer's associates, in a search for nuclei that would be more effective than the common nuclei that occur, hit on silver iodide as a nucleating agent because its crystal formation is nearly identical to that of the ice crystal. Silver iodide proved to be effective at —4° C. as compared to the —12° to —30° C. temperatures required for most natural nuclei. These are the discoveries on which cloud seeding experiments were based. They have led to extensive commercialized cloud seeding and to much controversy as to their value in increasing precipitation.

Experimentally, some striking results from seeding have been produced by both methods when deep cumulus clouds were seeded under the right combination of favorable conditions. The effects produced are then in the nature of a chain reaction or trigger action, like starting a fire from a single spark. But so far neither complete measurement of existing factors nor control of results can be assured in the free atmosphere. It is possible to overseed by providing so many nucleii that ice crystals cannot grow large enough to precipitate out. This relationship too has been applied by commercial cloud seeders in efforts to prevent rain.

Under drought conditions when there is a scarcity of moisture aloft, there is no possibility of correcting the situation by seeding. There must be a supply of moist air, and cloud-forming processes must be operating to replenish it. When there are abundant natural nuclei present artificial seeding might conceivably reduce the chances of precipitation rather than increase them. Under some conditions, silver iodide may oxidize in the air and lose its effectiveness.

The numerous evaluations of commercial cloud seeding that have been undertaken by the Weather Bureau and others, throw doubt on the economic returns to the rancher and farmer of the methods now employed. But evaluations are difficult, because conditions under which seeding of clouds has the best chance of increasing precipitation, are also the conditions under which natural precipitation is likely to occur. We have conducted an analysis of cloud seeding results over the Tillamook burn in Oregon, which is the only contract we know of that has been undertaken for the sole purpose of reducing fire danger. We found that kind of situation.

Because of the popularity of this subject, the extensive scale on which commercial cloud seeding is being practiced, and the complete absence of any legislation or regulations dealing with clouds or with moisture aloft, there have been many lively legal debates on the subject. Wyoming, Colorado, Oregon, Utah, and New Mexico have passed state laws on the subject and other states are considering similar laws. In Congress eight bills providing for regulation or experimention were introduced last year, but none was passed. In the 83rd Congress a compromise bill S-285, now known as Public Law #256, was passed and has been signed by the President. It provides for setting up an eleven-man advisory committee to be comopsed of the Secretaries (or a designee for each) of Defense; Agriculture; Commerce; Interior; Health, Education, and Welfare; the Director of the National Science Foundation; and five members from private life to be appointed by the President. It is the responsibility of this committee to make a complete study and evaluation of public and private experiments in weather control for the purpose of determining the extent to which the United States should experiment with, engage in,

[3] Arnold, R. Keith and C. C. Buck. Blow-up fires—silviculture or weather problems. Jour. Forestry 52:408-411. 1954.

or regulate activities designed to control weather conditions. The committee is to submit a final report and recommendations not later than June 30, 1956. Thirty days thereafter the committee will cease to exist.

Conclusions on effects of cloud seeding to date are given in a statement prepared in May 1953 by the American Meteorological Society.

The Council of the American Meteorological Society has continued to keep in close touch with the development of knowledge in the field of weather modification and control. Although the scientific background is still far from complete, the Council, as a public service, submits the following statements as a summary of present knowledge of weather modification and control. They amplify and extend the similar statements issued by the Council on August 15, 1951.

1. The seeding of a supercooled cloud with dry ice will usually convert at least a portion of the cloud to ice crystals. Under appropriate conditions such seeding will release variable amounts of precipitation from fairly deep and active cumulus clouds. Small, inactive cumulus clouds are usually dissipated when they are seeded with dry ice. Holes or valleys may be produced in supercooled layer clouds or supercooled fogs by seeding them with dry ice

2. The injection of small water drops or salt particles into the bases of deep, warm (non-supercooled) cumulus clouds will usually release variable amounts of rain if the vertical velocities in the clouds are substantial. Small, inactive, warm cumulus clouds may often be partially or completely dissipated by seeding them from above with certain materials; such dissipation may or may not be accompanied by rain of extremely light intensity.

3. In some cases warm fog and warm stratus may be dissipated in restricted regions by certain seeding agents other than dry ice or silver iodide.

4. It is known that silver iodide crystals will convert supercooled clouds to ice crystals at temperatures below about —5°C. It is therefore reasonable to expect that precipitation might be released from supercooled clouds by silver iodide seeding. Experimental evidence of positive results from silver iodide seeding is not yet as convincing as the results of dry ice seedings. Among the possible reasons for poorer results with silver iodide are the lower temperature required, the effect of sunlight on the silver iodide and some uncertainty as to the infection of the proper region of the cloud.

5. Cloud seeding acts only to trigger the release of precipitation from existing clouds. The release of substantial amounts of precipitation by either natural or artificial means requires the pre-existence of an extensive moisture supply in the form of moist air currents and of active cloud-forming processes. For this reason the meteorological conditions most favorable for the artificial release of precipitation are very much the same as those which usually lead to the natural release of precipitation. This makes the evaluation of the effects of seeding difficult and often inconclusive.

6. Statistical analyses, by independent agencies, have failed to show that the monthly or seasonal precipitation over a selected target area has been significantly increased by ground-based silver iodide seeding. Although these studies do not preclude the possibility that the precipitation can be increased they suggest that any increase has been relatively small.

7. Present knowledge of atmospheric processes offers no basis for the belief that the weather or climate of a large portion of the nation can be modified by cloud seeding. The results of experiments which have been conducted to explore such large-scale effects are considered to be inconclusive. Not all of the results are explainable in the light of present knowledge and further experimentation is desirable.

Such a statement must be most discouraging to the enthusiast who believes that we now have at hand the means of changing our climate to order, and to the rancher and farmer who hope to eliminate drought by such means.

The major factors that affect our climate such as the sun's radiation, the relation between ocean and land temperatures, and the great cyclonic air movements that emanate from the Bering Sea near the North Pole are forces that are still beyond the control of man by any foreseeable method. Nevertheless, scientists have made progress in understanding the process of cloud formation and dissipation and the physical processes by which precipitation occurs. Only the practical uses to which such information can be put for human benefits are in doubt. These will emerge in due time if continued active experimentation can continue. Out of such information it is reasonable to expect that continuing records and observations will enable us to define just when and where cloud seeding can produce a desirable local effect. Such effects might take the form of dissipating certain types of local thunderstorms before they have built up a dangerous lightning potential; increasing the snow pack during the winter season on critical watersheds and on winter sports areas; perhaps, on occasion, helping on a forest fire at critical times by inducing local showers or by suddenly creating increased humidities and lower temperatures; and in some areas, a net local increase in rainfall to the benefit of forest cover and water yield.

Such possibilities of value to the forest land manager seem more promising at this stage than the purposes for which much money has already been invested in commercial cloud seeding throughout our western country. The mysteries of air movement and storm development are not yet completely understood. Progress in solving them is a challenging thing to which our own research men should contribute and from which the practicing forester is bound to benefit.

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Trees and Taxes[1]

W. D. Hagenstein
Managing director,
Industrial Forestry Association,
Portland, Oregon.

A QUARTER of a century ago, the late forestry genius, E. T. Allen, writing about private forest owners said, "They want to perpetuate their industry and either utilize their property or put it in good condition for sale to someone who will"(*2*). Of course Allen was crystal ball gazing because, as the fire records show, forest protection was then hopelessly inadequate in the Pacific Northwest. Another fact of the times which precluded the practice of forestry in taxpaying ownership was that there was no more system to the assessing of values on timber and forest land under the ad valorem tax system than there is in most Oregon and Washington counties today.

Taxes and fire are surely the trouble twins of forestry.

Only since the advent of tree farming in 1941 has forest protection been established at a level which assures the long-term timber grower a return on his investment. Tree farms mean adequate forest protection, efficient cutting practices, necessary artificial reforestation and good wood utilization. Another tree farm requirement is stable ownership, and here is where taxation can gum up the works.

It's pretty obvious that when the assessed values on a section of timber could raise the taxes from $528 in 1907 to over $4100 in 1920, a 700 percent increase in only 14 years, no one could hold such land for long-term operation. How could anyone be interested in holding mature timber long enough or, putting it another way, cutting it slowly enough, to build up the age classes for continuous production when taxes were eating up the accrual of stumpage values, and then some! The age old theory in timber counties was that schools, roads and other public improvements must be built from taxes on virgin forests "before all the timber is gone." With assessments and tax rates based on the practice, "let's get it while the timber is standing," virtually every county in the Douglas-fir region at one time or another jeopardized seriously its own future. In fact, what a previous generation did was to mortgage our generation, just as we are mortgaging generations to come by our fabulous public expenditures today. The pressure for cash to pay ad valorem taxes, particularly during times when operating margins were negative or very small, caused the too rapid harvesting of tens of thousands of acres of mature timber for already glutted markets. Thus, many counties lost a principal part of their tax base, did away with their citizens' jobs, and generally reduced business. Tree farming in such counties has a long, hard pull ahead of it.

Timber assessment practices which failed to recognize that forestry can be practiced only with "wholesale" quantities of timber, forced in an earlier day a concept of "highest and best use," which in the timber business was the fastest practical liquidation to put an end for once and for all to taxes, risk and interest (*1*). What an utterly ridiculous economic theory as viewed by today's timber values and forestry concepts! But it was a very practical view when the public was biting the hand that fed it by assessing mature timber at a rate higher than the values of timber on the stump or its commodities in conversion could stand. Any bookkeeper knows, but the public seldom realizes, that taxes add to the cost, and in the case of timber at any given time its cost value is affected by accumulating taxes and interest. The point is that taxes accumulating against stumpage in themselves do not increase its value, only its cost. Many timbermen liquidated their holdings because of the disastrous economic effect of high assessed valuations.

Highest and best use is not theoretical. It is explained simply as the use that prudent and experienced men elect to adopt, and develop with their own money and find most rewarding. Today highest and best use of forest land as expressed by a substantial majority of landowners in the Pacific Northwest is long-term supplies of timber held for the maintenance of expensive wood-using facilities, while attempting to build up ultimately a perpetual operation. To accomplish this, such operators are now reducing their annual cut and purchasing outside timber supplies or tree-growing land. They are retaining their cut-over lands, investing large sums in artificial reforestation and forest protection, and developing by-product uses for leftovers from both woods and mill—all with an eye to future benefits. These long-range objectives of tree farming are stretching the old-growth timber supply and helping maintain thriving industries and payrolls. Such policy directly benefits the people in any area where forest products constitute the major share of the economy, because the real tax base in such circumstances is the earnings of forest industry workers. It's pretty obvious what the real tax base is in Washington and Oregon where the value of forest products in 1952 was more than 1.8 billion dollars. This represents $475 worth of forest products for every man, woman and child and an annual payroll of nearly $700,000,000.

With about half the forest land in Oregon and Washington in taxpaying ownership, the growth, harvest and utilization of timber will always constitute an important part of the ad valorem tax base. However, the value of the land and the timber growing upon it will never exceed on any basis the value of the tremendous payroll which the forest industries provide each year. Actually, with Oregon raising most of its state revenue from a personal income tax, and Wash-

[1]Adapted from an address before annual meeting, The Truck Loggers Association, Vancouver, British Columbia, Jan. 15, 1953.

ington from a retail sales tax, the ad valorem tax is used primarily for the maintenance of local government. In both states some of the income and sales taxes are returned to local government as part of its regular revenue. Because of the importance of forestry and the forest industries in the economy of the Pacific Northwest, assessment methods and taxes are a fundamental consideration in private timber growing investment. It's strange—for half a century foresters have warned the public that forestry could be precluded by unwise taxation policies, but throughout the land such policies are still the order of the day (*1*). Real progress has been made in forest protection, and although many have studied forest taxation and advanced many solutions to the problem, it still is largely an unsystematic jangle of antiquated valuation theory, old fashioned and ill fitting formulae and uncorrelated assessments.

For solution of the taxation problem confronting the Douglas-fir industry, the Industrial Forestry Association engaged in 1951 Mr. Julian E. Rothery of Massachusetts, a nationally known timber valuation engineer and forester, to make a study of assessment procedures and ratios, taxation structure and the relative treatment of timber and timberlands as compared with other classes of real property in Oregon and Washington. In 1952 his study was published in a concise copyrighted volume (*7*). This work sets forth in simple and easily understandable language current assessment practices, timber valuation principles and practices, and demonstrates how time affects the value of mature and immature timber. The Rothery study facilitated the excellent start made by the State Tax Commission of Washington which in 1952 issued an appraisal manual for timber and timberlands. The authors of the manual recognize the important element in timber value when they say, "The value of timber which can be cut and delivered currently differs considerably from the value of similar timber which, by reason of being inaccessible, must be held for future cutting. Timber cut currently will bring current prices and its value on the stump is directly reflected by such prices. However, if the timber is not accessible the elements of interest on investment, accumulating taxes, uninsurable risks from fire, insects, windthrow and unpredictable market conditions, all create a carrying charge which must be allowed in determining stumpage values. The longer timber must be held, the greater the carrying charge and, consequently, the value which can be placed on the stumpage is lower" (*3*).

The Tax Commission's assessment manual recognizes the effect of time on the value of timber, thereby realizing that timber which will be cut thirty years from now, for example, is worth considerably less than timber which will be cut today. Nevertheless, the manual contains an opinion of the attorney general of the State of Washington which says, "For the purpose of determining the true and fair market value of timber as required by Amendment 17 to the Washington Constitution, and assessing the timber at 50 percent thereof, timber which is so situated that it is possible of immediate harvesting is worth no less by reason of the fact that the owner has elected not to harvest the same in the year of assessment, or even that he has elected to wait as long as 10, 20 or 30 years before cutting." This statement means, if interpreted literally, that no private owner in the State of Washington can practice forestry, because he cannot open up his timber with the roads necessary for harvesting and protection without ultimately making all his mature timber subject to retail assessments. This, of course, would promptly put him out of business.

Forest industry in the Douglas-fir region wants neither subsidy nor preferential treatment. It wants merely the opportunity to hold its own land, practice forestry on it, and make a reasonable return on its investment, rather than have its timber growing costs multiplied by inequitable taxation and interest. Timber ownership and wood-using industries are part of each local community and expect always to share in the cost of community affairs. Tree farmers ask only the same treatment accorded other classes of real property. However, they ask recognition by assessing authorities that even though their growing forests accumulate wood each year, it is possible to derive income from them only periodically and the time may vary from 25 to 80 years. This means that under tree farming the true cash value of both mature and immature timber must be discounted to present worth when assessing its current value for ad valorem taxes. It means that adequate allowance must be made for interest, risk and taxes which must be paid while the trees are growing to revenue size. It indicates clearly the principal difference between trees and other soil crops because the former must be grown in "wholesale" lots. Hence their value for either taxation purposes or for sale is a wholesale price, because a tree farmer cannot harvest all his trees in one or two years.

County assessors are greatly confused today by the fantastic prices bid for government timber when compared with the assessed values on their rolls for privately owned timber. What they overlook is that a government timber sale of one or two years' duration is a "retail" transaction. These retail purchases can be bought for a relatively small down payment with most of the purchase price being paid out on the basis of "pay as you cut." The government furnishes the fire protection and carries all the risk. On the other hand, when one buys 10, 20, 30 or more years' supply of timber from a private owner and fully expects to furnish fire protection, pay interest and ad valorem taxes, and incur the uninsurable risk to all or part of his investment, he must discount adequately to determine what he can afford to pay for such timber. The Rothery study outlines the principles involved in this calculation and shows clearly by simple arith-

metical example how it is done.

Another substantiation that government timber sales are at "retail" is that current O&C sales in Oregon average less than 2 million board feet and the average Forest Service sale in the Pacific Northwest is only about twice as large. Private sales often run from 50 or 60 million up to several billion board feet. The market price for such wholesale transactions takes into full consideration the necessity for discounting adequately for interest, taxes, fire protection, and risk.

In addition to the ad valorem tax system which has been discussed previously, a forest landowner does have the opportunity of classifying his lands under the Reforestation Tax Act in Washington or the Forest Fee and Yield Tax Act in Oregon. These acts are very similar in that they allow a landowner to have immature timber and cut-over lands classified under the acts which takes them off the ad valorem rolls. In Oregon the act calls for a fixed fee on the land of 5 cents per acre per year west of the Cascades and 2½ cents on the east side. In Washington the law provides an assessed valuation of one dollar per acre in the Douglas-fir region and 50 cents per acre in the pine region, with the current millage levied against that value. The average annual tax on the land in western Washington has been about 4 to 5 cents. Under both of these statutes when timber is harvested from classified lands a yield tax of 12½ percent of the market value of the stumpage is payable. The stumpage value is appraised by the state forester. In Oregon the 12½ percent yield tax is effective immediately upon classification, whereas in Washington it is a cumulative tax of one percent a year for the first 12 years and thereafter 12½ percent.

Actually, there has not been too much land classified under these two statutes despite the fact that they have been on the books since 1929 and 1931 in Oregon and Washington respectively. There are several reasons for lack of interest in these yield tax propositions. Many forest landowners have felt that the 12½ percent yield tax is too high a proportion of the total return from mangrown stumpage. Others feel that until a landowner's policy for holding his property has been determined, classification constitutes a cloud on the title, which would be disadvantageous in the event of sale. The acts call for a complicated bookkeeping procedure which adds to a landowner's costs. Until recent years the assessed valuations on cut-over land have been so nominal it was more economic to leave lands under the ad valorem system than to request classification for yield tax treatment. Many assessors feel the policy of the state legislature in adopting yield tax legislation has set a floor of assessed valuation on cut-over land. This is unfortunate, because it is driving the assessed valuation of immature timber and cut-over land up rather sharply at present. The Rothery study investigated this proposition, as did the Industrial Forestry Association the previous year. The latter study, which sampled every county in western Oregon and Washington, found there was little system to the assessing of values on immature timber (*5, 6*). One would expect increasing assessed valuations with increasing age and hence value, but, except for the large number of samples in the study which showed a very slight correlation of ascending value with ascending age, it was readily apparent there was little system to the whole procedure.

Because assessors are just beginning to assess values on the basis of a systematic procedure, it seems a bit early to suggest it, but it is the writer's opinion that ultimately the only equitable means of taxing forest land under the ad valorem system, or a substitute for it, is on the productive capacity of the land itself. In other words, taxing its ability to grow timber. Whether this should be done by means of an annual levy, which is probably more desirable from the county standpoint, or by a yield tax at the time of severance, has yet to be worked out. It is the biggest single problem confronting the tax commissions in Washington and Oregon today. It is their responsibility to maintain in private ownership the better half of the timber-growing capacity of two states whose forest industries support 50 percent of their economy.

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What's in a Name? Notes on *Pseudotsuga menziesii*

John M. Pierovich
Corvallis, Oregon.

IT HAS been humorously suggested that plant taxonomists have as their principal objective the upsetting of well-established names. Western foresters have recently been given cause to ponder this statement and to wonder if it might be true! Why, we ask, must Douglas-fir lose its well-known specific name of *taxifolia*, suddenly to become *menziesii*?

This was almost as much a shock to us as it would have been to have our good friend Paul Bunyan turn up to work one morning with the new handle of Joe Doakes. Rumblings of the "Law of Priority," the "International Code," and the "Check List" have done little to satisfy the aroused curiosity (or to offset the dissatisfaction) of brush-monkey or scientist.

Born of this curiosity, this paper briefly explores some of the more important changes in nomenclature that have occurred between the 1927 and the new, 1953, U. S. Forest Service *Check List*, and attempts to see if the Paul Bunyans of the plant kingdom should be allowed to have their names changed at all. Because most of the recent controversy is centered around the Douglas-fir name change, considerable attention is given to the "Law of Priority," and to what the writer feels is an abuse of this law. It is hoped that foresters will be encouraged through this review, to actively urge further stabilization and uniformity in nomenclatorial procedure. To this end, some recent proposals are reviewed, and it is suggested that the Society of American Foresters give consideration to sending an instructed delegate to future sessions of the International Botanical Congress.

The New Check List

The confusion which might result from widespread non-uniformity of tree names used by U. S. foresters can be envisioned with little tax on the imagination. And recognizing that uniformity is desirable, one cannot question the worth of such a publication as the U. S. Forest Service *Check List of Native and Naturalized Trees*, by Dr. E. L. Little (*19*). After the first shock of finding some of the old names changed, it is not hard to accept the standardization which it affords, and the volume is a welcome addition to any forester's library.

It is unfortunate that a book dedicated to uniformity must reject several familiar names, replacing them with others which were not applied in Sudworth's 1927 *Check List*. Of the important trees, however, just one genus (the hickories) and only a few species and varietal names are changed. We can hope that these changes will, for the most part, serve to reduce much of the confusion which one encounters in our present forestry literature. Some of the changes concerning the more important commercial trees are listed in Table 1.

From the reasons given for changing the names (Table 1), and from a similar table of generic changes appearing on page 21 of the *Check List*, it is obvious that there are numerous possible justifications, or motives, which may be considered valid. The legality of these reasons is determined by interpretation of the *International Code of Botanical Nomenclature* (*11*) which is, itself, subject to revision at each Botanical Congress. New proposals intended to increase uniformity in plant nomenclature have made progress in the elimination of needless changes. However, it is not universally agreed as to what constitutes a reasonable change. A starting place for evaluating the changes made might well be a consideration of the purpose which is to be served. In the section following, only one change has been considered out-of-bounds when the test of purpose was applied.

Reasonable Changes in the New Check List

Of the seven name changes which are listed in Table 1, all, except that of *Pseudotsuga menziesii* (Mirb.) Franco, appear to serve constructive purposes, and to be based upon prudent interpretations of the International Code. In these the Forest Service has followed the Code to (1) eliminate a superfluous name; (2) eliminate the confusion associated with the various spellings of a generic name—and one which was never validly published;

TABLE 1.—SOME CHANGES IN NOMENCLATURE APPEARING IN THE 1953 U. S. FOREST SERVICE CHECK LIST.

1953 List	1927 List	Common name	Reason changed
Betula alleghaniensis Britt.	*B. lutea* Michx. f.	yellow birch	Technically superfluous & a *nomen illegit.*
Carya Nutt.	*Hicoria* Raf.	hickory (genus)	Conservation under Int'l Code to eliminate confusion.
Pinus elliottii Engelm.	*P. caribaea* Morelet.	slash pine	New information resulting in revision.
Pseudotsuga menziesii (Mirb.) Franco	*P. taxifolia* (Poir.) Britt.	Douglas-fir	Law of Priority.
Quercus michauxii Nutt.	*Q. prinus* L.	swamp chestnut oak	Faulty interp. of Linne. Return to original names.
Quercus prinus L.	*Q. montana* Willd.	chestnut oak	Faulty interp. of Linne. Return to original names.
Quercus rubra L.	*Q. borealis* Michx. f.	northern red oak	Faulty interp. of Linne. Return to original names.

(3) introduce new information; and (4) effect, in the case of the oaks, a simplification by restoring original names for species which have become confused through interpretation of the very brief descriptions of Linnaeus (*12*).

With regard to the second point it is interesting to note that Sudworth (*25*), in the 1927 *Check List*, adopted the name Hicoria Raf. for the hickories, using the older name —and the one valid under the now obsolete "American Code." In this case, however, the International Botanical Congress rejected Rafinesque's naming and conserved Carya which had been used later by Nuttall (*20*). In an article in the *American Midland Naturalist*, Little (*13*) has presented an interesting history of the two names in detail, and has clearly shown ample reason for rejection of Hicoria Raf.; there appeared, in all, about eight spellings. Rafinesque's failure to make a valid publication of the name, and his own usage of several different spellings (*e.g.*: Scoria, 1808; Hicorius, 1817; Hicoria, 1838) made acceptance by his contemporaries unlikely.

The new information (point 3) which resulted in the change for slash pine from *Pinus caribaea* Morelet to *Pinus elliottii* Engelm. has been presented in an article by Little and Dorman (*18*) in the JOURNAL OF FORESTRY, December 1952. In this article Engelmann (*4*) is credited with first describing the species as distinct in 1880. The authors also cite several other workers who observed the variations upon which this species is recognized. They include descriptions of both *P. caribaea* and *P. elliottii*, with a key to identification of species and varieties. This change then is not a result of maneuvers within the intricacies of plant nomenclature, but is the outgrowth of field investigations which confirm distinctions between Caribean and slash pines.

A Needless Change Due to the Law of Priority

The Check List has been subject to some criticism (see Haddock [8] in "Points of View" in the February, 1954 JOURNAL OF FORESTRY) for acceptance of *Sequoia gigantea* (Lindl.) Decne., ". . . in the interest of uniformity and elimination of confusion in names . . .," despite its illegality due to a prior name, when on the other hand, priority was considered justification for the change for Douglas-fir. Although we may argue that this treatment was one-sided, may we not more profitably consider amending the Code to overcome such difficulties? Before discussing some proposals which have been made toward this end, it seems well to examine the extreme efforts misspent by Franco in establishing the priority. The reader is enjoined to apply the test of "to-what-purpose" to the result.

This section attempts to collect and summarize the arguments of two botanists, appearing over a period of four years (1950-1953) and in three publications, relative to the legitimate scientific name for Douglas-fir. The intricate nature of the bibliographic citations and the duplication of specific names do not lend themselves to casual reading. In substance, the following discussion shows (1) how, under the International Code of Botanical nomenclature, the specific name *taxifolia* is invalid for Douglas-fir due to its use in earlier, identical name combinations, the earliest of which applied to a different plant, and (2) that a new combination utilizing the specific name *menziesii* is valid.

When a systematist finds a hereto-fore forgotten name with an earlier date of publication than that of the name now in use, he may, if he wishes, under the International Code, Article 16[1], publish a revision. This "Law of Priority" makes possible the attributing of credit to the first person who legitimately describes a genus or species, and is ideally a satisfactory device. Certain difficulties are, however, encountered as in the case in point.

In 1950, João do Amaral Franco (*5*), of Portugal, introduced two plant names not listed in *Index Kewensis* (*10*). Of these, one was *Pseudotsuga menziesii*, a new combination based up what he considered to be the oldest legitimate name, *Abies menziesii* Mirb., for the species we call Douglas-fir. His argument for the acceptance of this name was that *Abies taxifolia* (Lamb.) Poir., upon which *Pseudotsuga taxifolia* (Poir.) Britt. had been based, was invalidated by the prior date of *Abies taxifolia* Desf. which did not describe the tree we know as Douglas-fir.

Dr. Elbert L. Little, Jr., (*17*), writing on the "Genus Pseudotsuga in North America" in *Leaflets of Western Botany* for April 1952, rejected Franco's combination, and retained *Pseudotsuga taxifolia* (Poir.) Britt. as a valid name for Douglas-fir. Little maintained that since ". . . it is not known which name had priority in 1804, *Abies taxifolia* Poir. or *Abies taxifolia* Desf., the former should be accepted by established custom (Art. 5)[2]."

Undaunted, Franco (*6*), in August 1953, published an article, "On the Nomenclature of the Douglas Fir", in which he explained arguments for the retention of his combination. Portions of these are abstracted as follows:

> The oldest publication of the name *Abies taxifolia* I found is in a very rare book, entitled *Tableau de l'Ecole de Botanique du Jardin des Plantes de Paris; ou catalogue general des plantes, ordres, genres et especes, d'apres les principes de la methode naturelle de A. L. Jussieu. Par un botaniste.*, published in Paris in the year VIII of the French Republican calendar (1800) . . . In that book, *Abies taxifolia* employed for European Silver Fir, is a *nomen nudum*[3], as well as all other quoted plant names. Later,

[1]Par. 3, Art. 16: "For any taxon below the rank of genus the correct name is the combination of the generic name with the earliest available legitimate epithet or epithets validly published with the same rank."

[2]Art. 5 *Int. Code Bot. Nom.*: "In the absence of a relevant rule, or where the consequences of rules are doubtful, established custom must be followed."

[3]*Nomen nudum:* "a plant name published without any description or figure and hence which cannot be tied in with assurance to any plant group. *Nomina nuda* are very properly rejected by all codes.—Dayton (*1*)

Abies taxifolia was published by DU TOUR in *Nouv. Dict. Hist. Nat.* 20:114 (1803) for the first species of the article SAPIN, referred to the generic name *Abies*, in the following way: "SAPIN COMMUN, SAPIN AGENTE, SAPIN BLANC, SAPIN A FEUILLES D'IF, *Pinus picea* Linn.; *Abies alba* Mill.; *Abies taxifolia* Mus[4]; tres grand arbre . . ." . . . It is difficult to decide if in this quotation DU TOUR meant to quote the name *Abies taxifolia* as the adopted name or as a synonym, but in view of the element of doubt I think it wisest to adopt it as validly (though illegitimately) published. However, from what will be explained further on, it seems unnecessary to spend more time with the matter.

In *Tableau de l'Ecole de Botanique du Museum d'histoire Naturelle*, by DESFONTAINES, published in Paris in 1804, the name *Abies taxifolia* appears on page 216, but is here followed by the synonym *Pinus picea* L. Thence *Abies taxifolia* was validly published in this book . . .

To this point, Franco has presented evidence of the first known (though illegitimately published) uses of *Abies taxifolia*, and of its further use by Desfontaines in 1804, referring to *Pinus picea* L. Following further discussion concerned with the work of Mirbel, he comes to the name *Abies taxifolia* assigned by Poiret (*22*) to the tree we know as Douglas-fir, in Lamarck's *Encyclopedie Methodique Botanique*, VI. Poiret therein gives a description based upon *Pinus taxifolia* Lamb. which had itself been assigned to our Douglas-fir. Franco says of this:

> . . . This last name (i. e. *P. taxifolia* Lamb.) is illegitimate as it is a later homonym[5] of *Pinus taxifolia* Salisb. . . . . a new name for *Pinus balsamea* L. *Abies taxifolia* Poir. cannot therefore be taken as a new combination, but could be legitimated as a new name if there was no older homonym.

It is about this point, i.e., the question of an older homonym, that the crux of the issue between Little (*17*) and Franco (*5* & *6*) found its origin, Little contending that *taxifolia* remained a legitimate name because it was based upon a combination which should be accepted by custom although its priority was not certain, and Franco arguing that *taxifolia* was illegitimate because of the prior application by Desfontaines (*3*) of this name to another plant.

In his 1953 argument, Franco (*6*) sets out to prove that of Desfontaines' (describing another tree) and Lamarck's (describing Douglas-fir) publications, Desfontaines' was the first, and therefore invalidating, use of *Abies taxifolia*. Stating that, "though both Desf. *Tabl.* and Lam. *Encycl. Meth. Bot.* 6 bear the year 1804 on the title page, this last could not have been published before 1805 . . . ," Franco then lists three reasons to substantiate this. These may be summarized as follows:

> "1 Exact bibliographic quotations (by Poiret) of the first volume of VAHL, *Enumeratio Plantarum* . . . published at the end of the year 1804 . . . ,
> "2 Exact bibliographic quotations of the 1st volume of PERSOON, *Synopsis Plantarum*, published after March 1805, made by Poiret . . ."

and -3- in which Persoon (1805) is cited as quoting the questioned 6th volume of Lamarck as "(ined.)" or unpublished. Franco says, "From this quotation, ... it seems clear that its publication could not antedate that of Persoon, *Syn. Pl. 1.*"

One cannot help but speculate here if the works of Vahl (26) and Persoon (21) might themselves have been unpublished when cited by Poiret. It would seem possible too that Poiret's work might well have been "ined." when cited by Persoon, but that it could have been published by the time Persoon was printed. What then is there to protect us from returning to P. taxifolia (Poir.) Britt. if these possibilities should become known fact? In other words, how many times could the hair be split?

However, under the Code and in light of the foregoing argumentation, the new combination *Pseudotsuga menziesii* (Mirb.) Franco, ". . . based on the oldest legitimate name for the species, *Abies menziesii* Mirb. in *Mem. Mus. Hist. Nat.* (Paris) 13:63, 70 (1825)," must be taken as valid. As such, it appears in the new U.S.F.S. *Check List*.

Proposals to Further Stabilize Names

From the tangle of bibliographic citations in the previous section, we can extract at least two things: (1) a great deal of digging was done to form a new combination for the scientific name for Douglas-fir; (2) we are faced with a new name for a species which has long been known by another. Logically, the question of "What has been gained?" comes to mind.

Instead of elimination of confusion, mild chaos has resulted, for example, resolutions by the Columbia River and Puget Sound Sections of the S.A.F. to ignore the new name.

It is especially unfortunate when a "system" becomes the instrument for confusion in an applied field which it should serve. *Pseudootsuga taxifolia* (Poir.) Britt. has long been in use by foresters and botanists, and because of the commercial importance of the species, changes in its nomenclature may be felt on a wider plane than that of the taxonomist. But it is to be hoped that a good cause will be served by what has happened to our old friend *taxifolia*. The interest aroused by the change may give impetus to more active consideration of some proposals designed to further stabilize plant names.

Relative to the Law of Priority

This paper has dealt at length with a result of the "Law of Priority," and it is logical that we should consider this law as an area of present misuse. The three proposals included in this section, although failing to pass in previous sessions of the International Botanical Congress and not under consideration at this year's Congress, are of interest to those of us who would like to see an end to needless changes.

Nomen Extinctum (A name dead so many years, will remain dead.)

[4] "Mus." here, according to Franco (*6*), used as an abbreviation for Museum d'histoire Naturelle de Paris. Little (*17*) questions the validity of such a citation, as a violation of articles 40 and 37 bis.

[5] *Homonym:* "The same name for a different plant; a specific or generic name untenable because preoccupied. For example, the generic name Pinus would be a homonym, and untenable, if applicable to any other group of plants than the Pines."—Dayton (*1*)

Little (*11*)[6] said in 1948 of the problem of reviving older names, "Perhaps the simplest would be the establishment of a . . . gentlemen's agreement not to take up these old names . . ." But he continues, ". . . As the temptation to revive an old name is great, voluntary agreement seems unlikely as a solution." With this in mind, he proposed that a name more than 100 years old, not subsequently accepted as valid, be rejected as a *nomen extinctum* if it is an earlier synonym or homonym of any other accepted name currently in use. This proposal, probably the simplest, has not been accepted, but might become a part of the *Code* if submitted with such backing as our Society and others could offer.

Nomina Specifica Conservanda (In substance, a check list.)—An all-inclusive list to be known as the *Nomina specifica conservanda* has been proposed and is strongly backed by the laity. This would be THE LIST, changed only by vote of the Congress. Among other objections, argue many opponents of this proposal, the tremendous proportions of such an undertaking would be prohibitive.

Nomina Specifica Rejicienda (Conditional rejection of an older name.)—Dr. T. A. Sprague (*24*) in September, 1951, opposing the conservation of species, suggests an alternative method, the *nomina specifica rejicienda*. Sprague points out that such a device would permit the conditional rejection of an older name, previously overlooked, and the retention of the name currently in use. He suggests that an International Bureau of Plant Taxonomy would make possible decisions relative to the acceptance or rejection of such names. The failure of this proposal at an earlier Congress is attributed by Sprague to inadequate preparation.

Relative to New Information About Genera and Species

Another area which deserves attention in an applied field such as ours is the legislation affecting changes and the transference of generic and specific names as new information on anatomical or cytological structure comes to light. As new species are determined, and as old ones are eliminated or are merged (either through evolutionary changes or through the application of new knowledge), it becomes necessary to find new classifications for them. Dr. H. A. Gleason (*7*) has said of this, "At present we do not know how to refer such plants to a place in our legislated categories, or how to give them appropriate names. Most of the confusion in taxonomy (is) caused by plants of this nature."[7]

One of the more promising proposals related to these problems is that made by M. B. Raizada (*23*), in October, 1953, which is reproduced as follows:

> Proposal:
>
> In order to avoid confusion and to save much trouble for a number of years to come, I propose the following amendments to the new regulation under paragraph 3 of Article 42:
>
> a. Names published by mentioning the older species to be transferred to a new genus should be considered valid: . . .
>
> b. Names published by the same method as *Polyalthia* of the *Genera Plantarum*, where the older names have not been mentioned, to be considered as not validly published at all.
>
> c. On and after a certain date to be fixed by the next botanical congress, only combinations actually made, i.e. *typographically expressed*, to be considered as valid for the future without retroactive effect.

At this writing it is not known what action has been taken by the Congress, but if this proposal is adopted, we can at least hope to trace the changes as they occur without the considerable research which this might otherwise entail.

Conclusions

It can be concluded from what has been considered that efforts are being made to get more system into systematics, and that we need not throw up our hands in disgust with the idea that the "systematists have as their main object the upsetting of well established names!" May we not also conclude, that as foresters who deal with plants subject to nomenclatorial changes, we should be sufficiently concerned with the legislation of the *International Code of Botanical Nomenclature* to urge, through our Society, the adoption of proposals to minimize current difficulties?

The writer does not wish to suggest more than that certain action is indicated. This might be the passing of a resolution (or resolutions) backing proposed changes in the Code, and the sending of an instructed delegate to the Congresses. This action should at least contribute to an appreciation of the needs of those who must apply taxonomy in their work, and could conceivably influence a favorable vote. Although the reviving of Little's *Nomen Extinctum* proposal, or of one to serve a similar cause, is now too late for action at this year's Congress (July), it would seem that the Society should lay plans now for future activity in this and other areas of taxonomic legislation.

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[6] It is significant that Little, although forced to accept Franco's change, has had much to say about digging up old names. See also References *15* & *16* by him under cited literature.

Of further interest are viewpoints on nomenclatorial difficulties as expressed by foresters William F. Harlow (*9*) and by William H. Dayton (*2*).

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It's An Ill Wind

Although winds of hurricane force are always anathema to the forester they sometimes turn up valuable data that fills in blank spaces for the historian.

An example of this is the great gale of 1222 which toward the close of that year caused havoc in the forests over almost the whole of England.

The windfall in the Royal Forests was so considerable that King Henry III issued orders to his forest officials not to interfere with any of the prostrate trees or broken branches until further orders and at once to proceed to draw up a careful valuation of their worth.

The King's correspondence with his foresters regarding this inventory of damage provides the only extant list of certain Royal Forests of the period, thus giving J. Charles Cox, author of that valuable study, "The Royal Forests of England," information not otherwise available. Some forty-one forests suffered very serious damage. Altogether there were some 64 of these Royal Forests at that period.

The King instructed the sheriffs of the counties in which the forests were, to place all money accruing from the sale of the windfall in some religious house within their jurisdiction, there to await further orders, and to place with it a roll giving full particulars of the sales, drawn up by a specially appointed clerk. *Taken from J. Charles Cox,* The Royal Forests of England, *London, 1905.*

R. P. HOLDSWORTH
University of Massachusetts

Recreational Facilities: A Potent Public Relations Force in Forestry[1]

Albert Arnst[2]
Portland, Oregon.

MANAGERS of public and private forest lands face several problems in bringing growing tree crops to economic and silvicultural maturity. These involve both physical and psychological considerations. Protection from fire, insects, and disease heads the physical list because it requires major capital investments and continued annual expenditures, and is complex in treatment.

Although insidious and deadly killers, insects and disease usually can be controlled or minimized by employing various silvicultural cutting systems or depending on chemical treatment. Silvicultural methods include sanitation and salvage logging to remove killed trees or those susceptible to attack. Insect epidemics sometimes also can be minimized or stopped by aerial spraying. These treatments have a common feature. They depend upon the application of a known science or technique which is almost completely under the control of the forest manager. He can do what he wants to do *when* he desires to do so. The degree of control is almost in direct proportion to the intensity of treatment.

Protection from fire is not so completely under the forest manager's control. It involves the evaluation, treatment, and control of two factors: *hazard* and *risk*. Other than that caused by blowdowns or insect epidemics, the *hazard* condition usually is one created by the forest manager through his logging or other activities which disturb the original vegetal cover. The amount of fire-feeding logging residue so created is partly under the control of the manager, because it varies according to his cutting plans, degree of utilization, and intensity of road development.

Fire *risk*, however, involves causative agents that may be beyond the control of the forest manager. Principal causes of fires include lightning, debris burning, logging operations, and the public in its use of forest lands for hunting, fishing, berry picking, hiking, camping, or sightseeing. Nationally, the percentage of man-caused forest fires in 1952 amounted to 73 percent. Incendiarists caused 33 percent of the fires and smokers and debris burners each 20 percent.

The forest manager cannot stop or control people from starting fires. He finds himself in the position of asking people *not* to start fires. He must therefore win public understanding of *why* fires are destructive and how they cause economic and recreational losses. Creating public consciousness that forest fires are bad is a psychological problem. A successful effort in that direction is being made by the Keep America Green program, sponsored by American Forest Products Industries in 35 states. Full public cooperation is the only real solution to a more effective reduction of fire risk from man-caused sources.

The private forest manager needs a still different kind of protection. He must be assured of a favorable economic climate throughout the rotation period of his timber crop. He must have fair and equitable taxation on the growing tree crop, minimum federal controls on privately owned tree-growing and wood utilization enterprises, a fair return on invested capital, and the continuing right to own and manage his own lands.

Thus the private tree farmer needs even more public understanding of his problems. If he doesn't gain it, he is apt to lose his battle for economic survival at the ballot box, because private enterprise can be legislated out of business through punitive laws. In an economic and political era characterized by a pronounced trend toward socialization of natural resources, "it can happen here."

The private tree farmer therefore shares with the manager of public forest lands the common problem of enlisting public support in preventing forest fires. He also assumes the additional burden of convincing people that his stewardship of a natural resource is as sincere and provident as that commonly, and sometimes fallaciously, attributed to publicly managed lands.

Within the last ten years America's private forest industry has become aware of this psychological problem and is trying to do something about it. Capitalizing on the definition "good performance publicly appreciated," many private companies are carrying on information or public relations programs designed to convince people that tree farming is in the interests of communities and citizens and not entirely for the sole economic benefit of a company.

Devices used in these expanded and costly public information programs range from printed bulletins and brochures to movies and show-me trips through woods and mills operations. Many of the programs are beamed on a community level, because informed employees and citizens must be the foundation of all sincere public relations work.

More recently, too, there has been a growing awareness in these programs that people respond more profoundly to emotional appeal than to logic. A straightforward and honest presentation of the dollar and cents value of timber harvests, the number of people employed, freight bills paid, and communities supported seems to stir up little enthusiasm in the

[1]Paper presented before the Division of Forest Recreation, annual meeting, Society of American Foresters, Colorado Springs, Colo., September, 1953.

[2]At the time this article was written Mr. Arnst was consulting editor of *Western Conservation Journal*, but has subsequently become managing editor of *The Lumberman*.

American citizen. The bread-and-butter approach may be convincing, but it doesn't excite!

One company has proved this by "baiting" its national advertising program, which appears in three mass-circulation periodicals. Reproductions of colored paintings feature wildlife, ranging from bear cubs and deer to otter and mountain lions in a tree farm habitat. Like the debutante posing on ship rail with a well displayed and shapely set of knees, animals never fail to draw public attention, in print or in "real life." The flood of requests for reproductions of these paintings proves that people will pause longer for sex and animals than for factory chimneys.

For the private tree farmer, there remains one additional means of winning public support and understanding, which has been little used. It is the fuller expansion of recreational facilities on tree farm lands. It is the unrolling of the "welcome" mat instead of the banning of people with fences, gates, and "no trespassing" signs. Recreational facilities include improved public camping and picnic grounds and the opening of tree farms to hunting, fishing, and berry picking.

In the western states the public relations potentials in well-planned and regulated programs of this "personal" type, compatible with saw log production, are beyond comprehension. Stimulated by a pleasant weekend in an attractive picnic area, the emotional reaction in the average John Q. Citizen is far-reaching and lasts through many years. It is particularly effective on the younger generation.

The fact that a company planned and furnished such facilities free elevates that company from the timber baron class and makes it a common public citizen, to be defended against all criticism of mismanagement. The U. S. Forest Service, largest single owner and manager of forest lands in the United States, long ago recognized this psychological principle and has capitalized on it.

Ever since Lewis and Clark in the 1800's blazed their pioneer trail to the Pacific Coast, the concept of free and unregulated public use of "wild lands" for hunting, fishing, and camping has been an accepted psychological attitude and social custom in the western states. The original forests provided timber for shelter, wood for fires, game for food, and retreat for the outdoor lover. The unfenced domain had no physical bars to full ingress and egress. It was the common man's land.

Favorable economics within recent years have made it possible for private forest industry to establish tree farms. These are privately owned, taxpaying lands, set aside for the permanent production of timber crops. The intensive and costly management systems initiated require among other things complete protection from fire. This protection usually has been obtained by banning from tree farm lands a public which is still indoctrinated with the philosophy that *all* forest land is wild land and subject to public use.

Tree farms in ten western states now total nearly ten million acres. About three million acres each are in Oregon and Washington. Although the primary purpose of these tree farms is to grow continuing supplies of raw materials for wood utilization plants, there is also a place for recreational facilities, where they are compatible with saw log production.

That recreational use of forest lands can attract large public audiences is proved by the statistical records of the U. S. Forest Service, which has had a long background of successful experience in this field.

In 1939, the national forests played host to over 14 million visitors. Half of these came to picnic, another 25 percent to camp, and the remainder were winter sport participants, etc. Another 20 million visitors came for the primary purpose of enjoying the scenery.

In 1951, the same national forest lands attracted 30 million visitors. Thirty percent came to enjoy the forest environment in campground areas, and another 24 percent were picnickers. An additional 65 million came primarily to enjoy the scenery.

Present one-time use capacity of all national forest camp and picnic areas is 41,000 family-sized units, or 310,000 people. Forest Service estimates indicate that an additional 10,000 units are needed to relieve present overcrowding.

The Forest Service is also in the saw log business. It sold 4.4 billion board feet of timber in 1951, which is about one-twelfth of the Nation's consumption of wood for all purposes. It is probably a safe assumption that few of the millions who have enjoyed the agency's well planned recreational facilities, some of them now furnished on a fee basis, have ever regarded the Forest Service as being in the saw log business or have seen any timber sale areas.

Yet the comparatively small acreage of lands devoted to recreational uses has been largely instrumental in selling the public the general premise that *all* lands under Forest Service stewardship are managed better than privately owned lands. In that chain reaction we also find that the public believes that national forest lands furnish the country's saw log supplies, even though 90 percent of that crop comes from privately owned lands. Recreational exploitation has created a public impression that the Forest Service *keeps* trees on the land for their esthetic values, while the lumberman strips his lands of all trees for personal economic gain.

This attitude of mind has led to a psychological and political situation in the United States which associates public land management with good practices and private land management with bad practices. It is manifested in the recurring attacks against private enterprise and in the establishment of conservation associations of "do-gooders" who have little real un-

derstanding of forestry facts or economics.

In the Douglas-fir region, for instance, an area clearcut to silvicultural standards looks about the same, whether it is on public land or privately owned tree farm land. Few people have the opportunity to make that comparison, because saw log management is usually carried on in the back country, not accessible to public travel. Recreational management, occurring in more accessible areas, therefore is projected as setting the standards for all land-use management of public agencies.

The recreational use picture on the national forests of Oregon and Washington demonstrates how a small acreage can create a favorable public impression. This does not imply that the forest management phases of the Forest Service's administration are below standard, but rather that the agency does not have to be continually on the defensive to defend its saw log production program.

In 1952, the 23 million acres of national forest land in the two States received nearly four million recreational visits. Nearly a million each came for picnicking and campground use. The rest were distributed among winter sports, recreational residents, primitive areas, and organizational campsites.

Facilities provided to attract these visitors included trailer sites, group picnic improvements, community kitchens, amphitheatres, community halls, sports areas, bathing and swimming areas, and ski areas.

Total acreage devoted to these recreational facilities was about 14,000, not including an additional 1,400,000 acres of wildlife and primitive areas. Only 5,414 acres were developed intensively as campgrounds, picnic areas, and combination campground and picnic areas.

In the 23 million gross acres of the same national forests, about 14 million acres have been classed as regulated commercial forest land, used in the computation of allowable annual cut for saw log production.

Thus about 14,000 acres dedicated to recreational use have been effective in establishing the general premise that the Forest Service is doing a better job of managing its saw log and other land use resources on 14 million acres than private landowners, who in general have not yet provided similar recreational facilities.

With a greatly expanding forest industry and an ever increasing population which has access to more roads, the problem of public entry upon private lands for the purposes of hunting, fishing, and outdoor recreation has indeed become a major one, particularly when it becomes inter-related with the problem of fire prevention.

Sportsmen's groups, women's clubs, outdoor writers, and pure conservationists are able to muster tremendous political pressures. If ignored, insulted, or treated discourteously, they can make things unpleasant for private enterprise.

There is no public power sufficient in strength to keep the public off privately owned lands. It is therefore far better to recognize the problem, meet it halfway, and cooperate with the public by allowing entry under controlled conditions.

This will be effective in bettering local community relations and in isolating fire risks in segregated areas. It will also be helpful in educating a large segment of the annual tourist "crop" that travels through the two states during vacation season. Such folks will return home with a more favorable impression of the courtesy of private forest land owners.

In 1952, over three million nonresident tourists came to the State of Washington. Their average length of stay was 7.6 days. Ninety percent came by automobile. One-third camped out while traveling. Oregon, in 1952, had one million tourist cars, bringing three million people.

In Washington, in 1952, the well-improved State Park system, with 60 units, attracted 231,257 overnight visitors and 2,901,165 day visitors. About half of the latter came for bathing and picnicking. The National Park system in the two states has experienced a growing traffic in recreational visits.

Private timber companies who have installed recreational facilities have found the results beneficial.

Crown-Zellerbach Corporation, Portland, Oregon, for many years has encouraged recreational use of its tree farm lands in the two states. The exception is in areas where safety of people is endangered by auto traffic, logging, or fire, or where the forest is in danger by added risk from forest fires which presence of people creates.

The company has given or sold at nominal cost to public agencies properties of high recreational value. These have been improved as State Parks. The company also has exchanged lands and timber with the U. S. Forest Service in highly used recreational areas, for timber in other parts of the forest.

More recently Crown-Zellerbach has constructed small parks to provide recreational areas for communities and the traveling public. It has set aside in a park the largest living Douglas-fir tree in the Pacific Northwest. Roads, a trail, and protection of trees have been provided. A small park at the entrance is furnished with tables, fireplaces, and sanitary facilities. A similar park has been developed on another tree farm.

Hunting, fishing, and berry picking have become big business. In 1950, hunters killed 501 deer, 185 elk, and 27 bear on Crown-Zellerbach Tree Farms. One farm checked through 4,500 hunters during weekends; they killed 200 deer, 3 bear, and 2 wildcats.

Hunters, fishermen, and berry pickers are allowed to use company roads when it's safe to do so. Access is controlled by gates at road entrances to the tree farms. Roadside beauty is being protected by careful logging.

Booth-Kelly Lumber Company, Springfield, Oregon, in 1952 made plans to develop three picnic areas. One has been improved in a second-growth stand with 15 tables, five fireplaces, piped water, toilets, and garbage pits. It has accommo-

dated one large picnic group of 600 people and many weekend users.

This year (1953) the company is starting on a second area which will have five tables and about three stoves. The three areas will serve about 100,000 people within easy driving distance. They have proved extremely successful in winning cooperation with neighbors and local people.

Hunters are allowed on the tree farm under controlled travel, and are checked in and out of the same gate. Each fall, about 3,000 hunters use the area. No warming huts or transportation are furnished and campfires aren't allowed. The area is patrolled in cooperation with the Game Commission. Cooperation has been excellent.

Employees are allowed specially allotted hunting areas. There is no hunting in operating areas, to protect crews on the job. Many fires and some vandalism have been eliminated in the hunting and picnic areas.

Rayonier, Inc., Hoquiam, Washington, plans to establish a camp at a popular spot. Company officials have found that the average hunter is a gentleman and will observe the minimum requests made for use of roads or other reasonable precautionary measures.

Cascade Lumber Company, Yakima, Washington, developed an area in 1949. Objective was to concentrate people in an area safe from fires. The improvements started with 18 tables, 7 or 8 masonry and metal stoves, sanitary facilities, and a playground. Reception by the public was gratifying.

Considerable publicity was received in the newspapers. The area has been used intensively by hunters, fishermen, picnickers, campers, and organizational groups. A favorable public reaction has resulted. There has been very little damage to the facilities. A second park area is being developed this year.

Roads are not closed during hunting season. The damage from 4-wheel equipment has been considerable. The company is cooperating with local sportsmen's groups to reduce this damage.

Weyerhaeuser Timber Company has developed five campground sites on the St. Helens Tree Farm and one on the Klamath Falls Farm. Several others are being established this year. One of these includes a swimming pool for youngsters. Facilities include tables, stoves, and sanitary facilities. Firewood is provided. The areas have received heavy weekend use and have won good community relations.

Hunters are accommodated during periods of non-fire closure. Some Weyerhaeuser tree farms don't allow hunters to drive beyond a certain point. Others allow cars on certain roads. Extra personnel are used on patrol, to reduce vandalism and assist hunters in getting out deer. One tree farm furnishes transportation in and out on speeders. Another furnishes cabins and coffee. All have gate-controlled access. Certain dirt roads are closed to traffic.

On all western tree farms big game hunting is a growing business. In the Douglas-fir region alone, in 1949, an estimated 7,469 deer and elk were bagged. Over 70,000 hunters were accommodated. The corresponding kill on ten national forests was 3,845. Tree farms furnish a more favorable habitat for game.

Some companies have entered into cooperative arrangements with State Highway Departments to help maintain public campgrounds, particularly with respect to garbage disposal. Brochures on company tree farms are maintained in hand-out racks on other tree farms. The improved areas are thus a good contact point to meet the public in a favorable and receptive mood.

The pressure for public entry on privately owned tree farms is particularly great in areas where there are relatively few publicly owned lands. It is in these regions that tree farms can best capitalize on the public's interest in recreational facilities.

Public entry upon private lands must be recognized as a privilege, not a right. The general public can be educated as to the limits of this privilege and the dangers that confront the private operator if these privileges are violated. This assumes that the private land owner will give some recognition to values other than saw log production, wherever it is possible.

Recreational facilities *can* be a potent force in public relations. Properly planned, they will enlist public support in fire prevention and will win better public understanding of the tree farmer's problems. Fuller improvement of recreational facilities is an effective means of convincing people that tree farms are also well managed and that the public interest is being considered.

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Simplified Computation of Volume and Growth[1]

Stephen H. Spurr[2]
School of Natural Resources, University of Michigan, Ann Arbor.

THE ANALYSIS of field data in the computation of volume and growth constitutes one of the most laborious phases of forest inventory. Just as photogrammetric methods have greatly increased the speed and precision of forest stand mapping, and as statistical sampling methods have produced more efficient and precise inventory designs, modern methods of machine calculation can be called upon to streamline and shortcut office computational procedures.

Simplified methods of volume and growth computation must rest upon two foundations: The first is a thorough knowledge of the basic laws of tree development and form. The second is that the volume and growth of the tree or stand must be expressed in simple mathematical terms with considerable accuracy before simplified computing methods can be evolved. Whether these relationships are expressed in graphs, formulae, or tables, they are still mathematical.

Once evolved, these expressions must be applied to a large number of data covering the dozens of condition classes and the hundreds of stands surveyed in the average large-scale inventory. The second foundation for simplified computational procedures, therefore, is a working knowledge of readily available automatic tabulating and computing machinery.

This paper deals with the computation of stand volume from conventional stand tables (tallies of trees by diameter classes), and the estimation of growth from supplementary site and increment-core data. It thus represents an effort to streamline conventional procedures by the application of fundamental mensurational principles and automatic computing machine methods. The principles have been discussed in detail in a recent work by the writer.[3] The machine methods can be followed through with any standard fully-automatic calculating machine—one that permits the accumulation of the sums of squares and products in a single continuous operation.

The efficient modern forest inventory will be based upon the wise use of aerial photographs, scientific sampling methods, and such tabulating devices as cumulative tally sheets and mark-sense tabulating cards. The addition of computational procedures such as are presented in the following discussion aid in getting reliable volume and growth estimates at the lowest possible cost.

Basic Volume Data

The first step in the simplified computation of volume involves the reduction of standard volume tables to local volume tables, and the expression of these local volume tables in the simplest possible form. Although this is the most laborious step in the procedure, the local volume tables may be used indefinitely. Once obtained, the solutions may be used until such time as better mensurational data become available.

To achieve the utmost simplicity, all volumes are computed on a total cubic-foot inside-bark basis. This basis permits the reduction of data to linear or near-linear regressions. It both simplifies and increases the accuracy of volume estimates and of growth predictions.

Once the final cubic-foot volume figures are obtained, board-foot and cordwood volumes are estimated by applying conversion factors to the cubic-foot volume. These factors may be changed as changes in markets or utilization necessitates a change in merchantable volume estimates. Regardless of market or utilization conditions, however, the basic volume computations—being on a total cubic-foot basis—can remain unchanged.

Choice of volume tables.—The intensity of most cruises does not justify the application of form-class volume tables. At the same time, composite volume tables based upon a single average form factor frequently are not sufficiently precise. For these reasons, standard volume tables (based on d.b.h. and total height) are generally chosen, and are modified and harmonized to fit the local forest conditions.[4]

Modification of volume tables.—The first step is to reduce each volume to a single regression line. For representative values throughout the table, the product of the diameter squared and height (D^2H) are computed. On arithmetic graph paper, cubic-foot volume is plotted over D^2H for each repesentative value. A single regression is thus obtained summarizing each volume table. These regression lines are generally linear for the larger D^2H values and slightly curvilinear for the smaller trees. They usually indicate that a single constant form factor is not applicable to the trees being studied.

In the event that a volume table must be converted from an outside-bark to a total cubic-foot volume inside-bark basis, the bark correction can be obtained from the growth plot data. For each diameter class, the mean square of the two diameters is computed on an automatic calculating machine. The relation of the mean square diameter outside-bark to the mean square diameter inside-bark gave the percent basal area in bark

[1]Paper presented at the annual meeting, Society of American Foresters, Colorado Springs (Colo.), September 1953.

[2]The material on which this paper is based was collected while the author was a member of the staff at the University of Minnesota. The illustrative material is selected from data gathered by graduate students working under the author's supervision at Ithaca State Park, Minn.

[3]Spurr, Stephen H. Forest inventory. The Ronald Press Co., New York. 1952. 476 pp.

[4]In the examples given, the volume tables were chosen from *Univ. Minn Agric. Expt. Sta. Tech. Bull.* 39 (Brown and Gevorkiantz, 1934; Tables 19, 109, 119) and *Forest Inventory* (Tables 18, 21).

for that class. The values are graphed and smoothed. It was assumed that the percent of the tree volume in bark was the same as the percent of the basal area in bark. The smoothed percentages can then be applied to the graph of the volume table to reduce the regression to an inside-bark basis.

After the volume solutions have been reduced to a total-volume, inside-bark basis, grouping may frequently be done. In the Itasca project, it was observed that the differences between several of the regressions (of volume over D^2H) were apparently less than the standard error of the estimate of the regressions. This being the case, there was no point in using a separate volume table for each species. The volume solutions were grouped, therefore, into three composite curves. Group 1 included red and white pine; group 2 contained the various hardwood species, balsam fir, and tamarack; while group 3 consisted of jack pine, white spruce, and black spruce.

The three volume solutions were harmonized to eliminate meaningless inconsistencies of a minor nature, and were reduced to a single *combined-variable* formula (*Forest Inventory*, Chapter 7). These are applicable directly for D^2H values of 3,000 and over and as follows:

Group 1—$Cf = 0.6 + 0.00233\ D^2H$
Group 2—$Cf = 0.7 + 0.00223\ D^2H$
Group 3—$Cf = 0.8 + 0.00213\ D^2H$

A simple table (Table 1) gives differing y-intercepts (regression constants) to take into account curvilinearity below a D^2H of 3,000. The volume of any tree can be determined, therefore, without reference to, or interpolation in, a volume table simply by multiplying the D^2H (diameter squared times height) of the tree by the appropriate regression coefficient and adding the appropriate regression constant.

Table 1 is actually a set of standard volume tables stated in the simplest possible terms. This simplification is made possible by formula presentation rather than by the conventional tabular presentation. Grouping the data to eliminate non-significant differences further simplifies the presentation. From this table, the volume of any tree can be computed quickly, well within the limits of statistical accuracy of the basic volume solution.

Board foot and cordwood volumes.—As stated earlier, the basic growth and management computations are based upon total cubic-foot volume estimates. Most foresters, however, are better able to comprehend board-foot and cordwood estimates. Such estimates also give at least rough indication of present merchantable condition. They may be obtained from the total cubic-foot volume estimates by use of the appropriate converting factor. These factors may be modified or changed as market and utilization conditions change or as better information becomes available without affecting the basic accuracy of the inventory and growth computations.

The board-foot conversion factors are developed separately for softwoods and hardwoods (Table 2). The ratios are readily obtained by dividing merchantable volumes by comparable total cubic-foot volumes and smoothing the results graphically.

The cordwood converting factors are entered as the number of cords per cubic feet rather than the conventional number of cubic feet per cord. This reversal of the expression permits multiplication rather than division in automatic-calculating machines and thus saves time. Actually the factors in Table 2 would be more useful if they read according to the square of the mean diameter rather than according to the mean diameter. The former value is readily obtained in

TABLE 1.—STANDARD VOLUME TABLES REDUCED TO COMBINED-VARIABLE FORM
Itasca management project

To obtain total cubic foot volume inside bark	GROUP 1 Red pine White pine	GROUP 2 Balsam fir Tamarack Aspen Paper birch Misc. hdwds.	GROUP 3 Jack pine White spruce Black spruce
Multiply D^2H by:	0.00233	0.00223	0.00213
Add for D^2H			
3000 and over	0.6	0.7	0.8
2500-3000	0.5	0.6	0.7
2000-2500	0.4	0.5	0.6
1500-2000	0.3	0.4	0.5
1000-1500	0.2	0.3	0.3
500-1000	0.1	0.1	0.1
0-500	0	0	0

TABLE 2.—FACTORS TO CONVERT CUBIC-FOOT VOLUME TO CORDWOOD AND TO BOARD FOOT VOLUME

Mean stand diameter	Converting factor[1]			
	For unpeeled cordwood		For International ¼ inch	
	Softwoods	Hardwoods	Softwoods	Hardwoods
5	0.0139	0.0152	0	0
6	.0135	.0147	2.5	1.2
7	.0132	.0143	3.5	2.3
8	.0128	.0137	4.2	3.0
9	.0125	.0135	4.7	3.7
10	.0123	.0132	5.1	4.2
11	.0122	.0129	5.4	4.6
12	.0121	.0127	5.6	4.9
13	.0120	.0125	5.8	5.1
14	.0119	.0123	5.9	5.2
15	.0119	.0122	6.0	5.4
16	.0119	.0122	6.1	5.5
17	.0119	.0122	6.2	5.6
18	.0119	.0122	6.2	5.6
19	.0119	.0122	6.3	5.7
20	.0119	.0122	6.3	5.7

[1]Cordwood values derived from values published by Gevorkiantz. Board foot values for softwood from comparison of Tables 100 and 109, Minn. Bull. 39; for hardwoods from Figure 8, *Forest Inventory*.

the computation procedure.

Construction of local cubic-foot volume tables by the volume-line method.—In the preceding section, we have seen how a number of standard volume tables can each be reduced to a single regression line. In this form, they can be grouped. Finally, they can be presented in simple tabular form (Table 1) so that the volume of any tree can be calculated quickly with a calculation machine if its diameter and height is known.

Since the measurement of tree heights is a relatively expensive operation, it has long been customary to confine accurate height-measurements to a relatively small sample of trees. From these data, a height-diameter curve is drawn up that permits the reduction of a standard two-variable (d.b.h. and height) volume table to a *local* or one-variable (d.b.h. alone) volume table. The chief difficulties in this method arise from the generally poor correlation that exists between height and d.b.h., and the highly subjective nature of the total height-d.b.h. curve which frequently results in biased curve-fitting diameter relationship and the difficulty of fitting a curve to the regression.

The construction of a local volume table can be greatly simplified and the solution rendered more accurate by utilizing the volume-line relationship. It has long been known in Europe that, if total cubic-foot volume is plotted against the square of d.b.h. (or against basal area) for a sample of trees taken from an even-aged stand, a linear regression results. This regression has been named the Gehrhardt-Kopezky volume-line. Actually, the volume-line is nothing more than a graphical presentation of a local volume table. Its merit lies in the fact that the regression of volume over d.b.h. is linear or nearly so if total cubic-foot volume is the measure of volume used, and if this measure is plotted against the square of the d.b.h. rather than against d.b.h.

To construct a local volume table by the volume-line method, it is necessary to measure a sample of trees, and to obtain for each tree both the d.b.h. to the nearest 0.1 inch and the total height to the nearest foot. These data may be obtained from the same trees analyzed for growth, and the measurements tabulated on the same field sheets (Table 3).

In the office, the volume of each sample tree is readily computed by machine without the necessity of any interpolation whatsoever. First, the d.b.h. is squared. This D^2 value for each tree is entered on the field sheet (column 12) as it is needed later. Second, D^2 is multiplied by the total height to give D^2H (column 13). Finally, the total cubic-foot volume is found by multiplying this D^2H value by the appropriate factors from Table 1. This last step may be speeded up by locking the volume factor (in this case, .00233) in the machine, thus necessitating the entering of only one number for each multiplication. In the examples cited in Table 3, note the sloughing of nonsignificant values as the calculation progresses: the diameter squared is entered to the nearest square inch; the D^2H is rounded off to the nearest 100; and the cubic-foot volume is entered to the nearest cubic-foot (or 0.1 cubic-foot for trees less than 10 cubic feet).

Once the cubic-foot volumes have been obtained (again note that no interpolation has been necessary), the volume of each tree is plotted over its diameter squared (Fig. 2). A straight-line relationship is obtained, and volume-line regression can be readily drawn. Contrast this with the wide scatter of points and the difficult curve-fitting of the same data in the usual height-over-diameter curve (Fig. 1). The equation for the volume-line may be read directly from the graph or it may be computed by linear regression analysis (*Forest Inventory*, pp. 116-119). It is:

$$V = 0.198\ D^2 - 2.5$$

The standard error of the estimate is 2.44 cubic feet, or only 6.7 percent of the mean tree volume of 36.6 cubic feet. This mathematical expression of the volume-line relationship is used in all future volume computations for the stand or stands sampled by this particular set of individual measurements.

Although a volume-line solution may be developed readily from as few as 10 trees, the individual tree data will ordinarily be grouped to the fullest extent possible so that the fewest local volume solutions will be needed. In the Itasca Project, for example, all the data from the extensive 130-year-old red pine type were grouped. Most of the individual measurements were obtained from a 5-acre permanent sample plot, from which the following local volume solutions were obtained by the volume-line method:

Red pine—$V = 0.201\ D^2 - 3.0$
White pine—$V = 0.202\ D^2 - 3.2$
Jack pine—$V = 0.185\ D^2 - 2.2$
White spruce—$V = 0.193\ D^2 - 4.2$

In all cases, the fit of the volume-line was linear except for the very smallest trees near the origin of the graph. The contribution of

TABLE 3.—INDIVIDUAL TREE DATA FOR LOCAL VOLUME TABLE CONSTRUCTION AND GROWTH ESTIMATION[1]

1 No.	2 Sp.	3 CC	4 DBH	5 DBT	6 DIB	7 IODG	8 dib 10 yrs. ago	9 Ht	10 Age	11 Rot	D	12 D^2	13 D^2H / 100	14 CF
1	RP	D	20.0	1.6	18.4	0.8	17.6	97	(153+R)	8.2		400	388	91
2	RP	I	16.3	1.6	14.7	.5	14.2	(71)	170+2			266	189	45
3	RP	D	20.2	1.8	18.4	.3	18.1	88	207+3			408	359	84
4	RP	C	20.7	1.8	18.9	.6	18.3	96	196+5			428	411	96
5	RP	D	21.3	1.9	19.4	.7	18.7	91	176+5			454	413	97
6	RP	D	20.5	2.0	18.5	1.4	17.1	97	(120+R)	9.3		420	407	95
7	RP	D	19.5	1.8	17.7	.5	17.2	89	205+1			380	338	79
8	RP	I	13.1	1.7	11.4	.4	11.0	(64)	215+3			172	110	26
Sum								558	1188					
N								6	6					
Mean								93	198					
Sum of squares			2928		2066		1910		154					

[1]Red pine old growth, Preacher's Grove, Itasca State Park, Minn., July 1952.

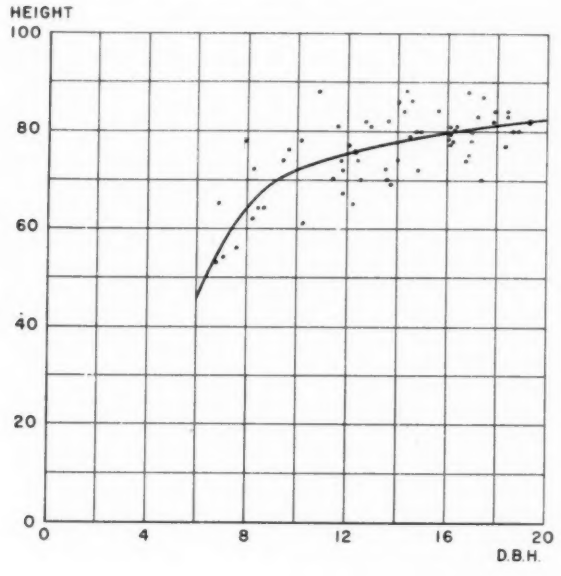

FIG. 1.—Height-diameter curve for red pine—1948 measurements of 5-acre plot, Itasca State Park, Minn.

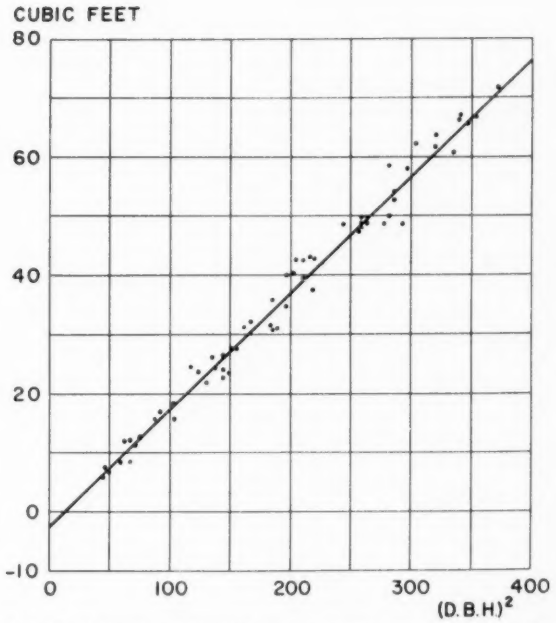

FIG. 2.—Volume-line solution for same trees represented in Figure 1. Note linear regression and tight scatter.

these trees to the total volume of the stand was so small that this slight curvilinearity could be ignored without affecting stand volume estimates significantly.

The local volume table developed for red pine in this instance may be compared with the same table developed from the same data by the conventional height-over diameter curve, followed by interpolation in a standard volume table. Table 4 gives this comparison for the 130-year-old red pine on the 5-acre sample plot.

The local volumes tables in columns 2 and 3 were developed by curving height over d.b.h., interpolating for each d.b.h. in a standard volume table, and constructing the local volume table in the tabular form presented. The values in column 3 have been divided by the corresponding values in column 2 to give the board foot-cubic foot ratios given in column 4. These ratios show obvious inconsistencies and expose two errors in the cubic-foot table (for d.b.h. 9 and 27). In this method, errors of interpolation or of extension upward or downward occur readily and cannot be picked up on casual inspection.

The cubic-foot local volume table in column 5 is merely the tabular representation of the volume-line solution given above ($V = -3.0 + 0.201\ D^2$). In actual use, the formula would be used and this tabulation would never be made. Note, however, the close agreement between the two cubic-foot local volume tables (except where the conventionally constructed table is in error), and the ease of extension by formula in the volume-line method. The board foot-cubic foot ratios in column 7 are copied directly from Table 2. The board-foot local volume table in column 6 is constructed simply by multiplying these factors by the corresponding cubic-foot volumes. This readily derived table corresponds closely to, and is more consistent than, the laboriously constructed conventional board-foot table in column 3. There seems to be no question but that the volume tables constructed by the proposed methods are preferable both in time required and in accuracy to those

TABLE 4.—COMPARISON OF LOCAL VOLUME TABLES CONSTRUCTED BY CONVENTIONAL AND VOLUME-LINE METHODS
Itasca 5-acre plot, 130-year-old red pine

	Conventional construction			Proposed construction		
1	2	3	4	5	6	7
D.b.h.	Cf	Bf	Bf/Cf	Cf	Bf	Bf/Cf
5				2.0		
6	3.0			4.2	11	2.5
7	6.4	28	4.4	6.8	24	3.5
8	10.2	34	3.3	9.9	42	4.2
9	11.6	67	5.8	13.3	63	4.7
10	17.7	89	5.0	17.1	87	5.1
11	22.3	115	5.2	21.3	115	5.4
12	26.3	143	5.4	25.9	145	5.6
13	31.5	177	5.6	31.0	180	5.8
14	36.9	211	5.7	36.4	215	5.9
15	42.8	251	5.9	42.2	253	6.0
16	48.7	293	6.0	48.5	296	6.1
17	55.0	335	6.1	55.1	342	6.2
18	61.8	377	6.1	62.1	385	6.2
19	69.4	429	6.2	69.6	438	6.3
20	77.0	475	6.2	77.4	488	6.3
27	95.0	700	7.4	143.5	904	6.3

constructed by conventional methods.

Volume Computation for the Single Stand or Condition Class

Basic parameters. — Once the basic volume data (local volume solutions and converting factors for cordwood and board feet) are determined, the various volume estimates may be secured from the usual *stand table*. Table 5 is such a stand table which gives the number of trees of each species in each diameter class. Such a table may have no provision for subtotals, or —as in Table 5—it may make provision for a breakdown of estimates by groupings such as *pole timber* (5 through 9 inch classes), *small saw timber* (10 through 15), and *large saw timber* (16 inch class and up).

The stand table presented in Table 5, however, has one printed item added to the usual form. This is the square of the diameter which is entered immediately following d.b.h. From this value—which can readily be memorized if necessary —the basic parameters describing the stand can be readily computed by use of an automatic calculating machine.

The procedure is simple. For each class, the diameter squared is multiplied by the number of trees, and the products are accumulated. Subtotals for broad groupings may be entered if desired. Otherwise, no figures need to be copied down until the accumulated sum of products (D^2N) is reached by the single computing machine operation. From this value and from the number of trees (N), all other stand parameters may be computed.

Basal area is obtained by multiplying the sum square (D^2N) by the factor 0.005454. With an automatic computer, this factor is entered into the keyboard and locked in. A whole series of D^2N values may then be converted to basal areas simply by entering each value once and then pushing the multiplication key. The factor is entered only the first time.

The square of the mean diameter (defined as the diameter of the tree of average basal area) is not determined from the basal area. Rather, it is obtained by dividing D^2N directly by the number of trees (N). This measure is used to determine the proper factor to convert cubic-foot volumes into board-foot and cordwood volumes. If the *mean diameter* itself is desired, it may be obtained by looking up the square root of this quotient (D^2N divided by N) in a good table of squares. Barlow's tables[5] generally are faster in this regard than is the calculating machine. As pointed out above, this step may be eliminated if the merchantable volume converting factors are based upon the square of the mean diameter rather than the mean diameter.

The stand table tally (Table 5) provides space for the entering of basal areas and mean diameters for each species and for the entire stand. Although the illustration is based upon a single stand tally covering 5 acres, a single calculation may be made for all stands in one condition class if the volume estimates are desired on that basis.

Cubic-foot volume. — From the two summation values, number of trees (N) and sum squares of diameters (D^2N), the basic parameters of basal area (B) and mean diameter (D) are derived. From these data, cubic-foot volume is obtained.

To obtain cubic-foot volume, it is necessary only to multiply the volume-line equation by the stand table summation values. The volume-line equation takes the general form:

$$V = a + bD^2$$

This applies to any single tree. For a stand of N trees, however, the formula must be multiplied through by N:

$$NV = aN + bD^2N$$

TABLE 5.—STAND TABLE

Itasca 5-acre plot, 130-year-old red pine, 1948 measurements

	D.b.h.	D^2	Species RP	WP		WS	BF	PB	TA	Total
Pole Timber	5	25	22	1		29	64	37	6	
	6	36	30	3		21	28	15	1	
	7	49	42	6	1	8	11	6	2	
	8	64	49	8	1	4	6	4	1	
	9	81	35	14	2	2		1		
	N		178	32	4	64	109	63	10	460
	D^2N		9,659	2,073	275	2,291	3,531	2,096	348	20,273
Small Saw Timber	10	100	44	9	9	1	1			
	11	121	44	9	6	2	1			
	12	144	63	12	10	2				
	13	169	75	6	9					
	14	196	60	5	7					
	15	225	68	3	3					
	N		354	44	44	5	2			449
	D^2N		58,531	6,386	6,634	630	221			72,402
Large Saw Timber	16	256	55	2	3					
	17	289	47							
	18	324	23	1						
	19	361	10	1						
	20	400	8							
	21	441								
	22	484		2						
	27	729	1							
	N		144	6	3	1				154
	D^2N		42,654	2,165	768	324				45,911
Total	N		676	82	51	70	111	63	10	1,063
	D^2N		110,844	10,674	7,677	3,245	3,752	2,096	348	138,586
	B		604.5	57.9	41.9	17.7	20.5	11.4	1.9	755.8
	D^2		164.0	129.6	150.5	46.4	33.8	33.3	34.8	130.4
	D		12.8	11.4	12.3	6.8	5.8	5.8	5.9	11.4

[5]Comrie, L. J. Barlow's tables. Fourth edition. Chemical Publ. Co., New York. 1952. 258 pp.

TABLE 6.—STAND OR CLASS SUMMARY OF VOLUME

Stands: 130-year-old red pine
SE¼ SE¼ Sec 4, T143N, R36W
Clearwater County, Minn. (Itasca State Park)
Area: 5.00 Ac.

By: SHS
Date: 7/15/51

Reciprocal: 0.200

	Species							
	RP	WP	JP	WS	BF	PB	TA	Total
Cubic Feet								
Factor	0.201	0.202	0.185	0.193	0.203	0.200	0.200	
Minus	03.0N	3.2N	2.2N	4.2N	4.0N	3.0N	3.0N	
Pole (5-9)	1,407	316	42	173	281	230	40	2,489
Small saw timber (10-15)	10,703	1,149	1,130	101	37	...	...	13,120
Large saw timber (16+)	8,141	418	135	58	...	...	...	8,752
Total	20,251	1,883	1,307	332	318	230	40	24,361
Board feet (5 +)								
Factor	5.8	5.5	5.6	3.3	2.0	1.0	1.1	
B.F.	117,460	10,360	7,320	1,100	640	230	40	137,150
Cords (5-9 only)								
D^2	54.3	64.8	68.8	35.8	32.4	33.3	34.8	
D	7.4	8.0	8.3	6.0	5.7	5.8	5.9	
Factor	0.0130	.0128	.0127	.0135	.0136	.0148	.0148	
Cords	18.3	4.0	0.5	2.3	3.8	3.4	0.6	32.9
Per acre values								
N	135	16	10	14	22	13	2	213
B	120.9	11.6	8.4	3.5	4.1	2.3	0.4	151.2
D	128	11.4	12.3	6.8	5.8	5.8	5.9	11.4
CF	4,050	377	261	66	64	46	8	4872
BF	23,490	2,070	1,460	220	1,130	50	10	27,430
Cds (5-9)	3.7	0.8	0.1	0.5	0.7	0.7	0.1	6.6

The cubic-foot volume of the red pine portion of the stand table in Table 6 is thus obtained by substituting N and D^2N in the volume-line solution for red pine given above:

$V = -3.0\,(676) + 0.201\,(110{,}844)$

The cubic-foot volume of the red pine in this 5-acre stand is thus 20,251 or 4,050 cubic feet per acre.

The above calculation is carried out in one step on a fully-automatic machine. The slope coefficient (b) is first multiplied by D^2N. Then, without copying down the results or clearing the machine, the y-intercept (a) is multiplied by the number of trees (N) and the result subtracted at the same time from the first product. The cubic-foot volume is then read directly from the machine.

The computations for the entire stand are shown in Table 6. In this instance, cubic-foot volumes are computed for each diameter grouping. It is equally possible to compute volumes for each diameter class, or to ignore all minor breakdowns and compute the stand volume in one operation without entering any subtotals whatsoever.

For contrast, the conventional stand and stock table computations using tabular local volume tables is presented in Table 7. Inconsistencies in the local volume table picked up in Table 4 have been corrected. For each diameter class, the volume per tree (column 3, *local volume table*) is multiplied by the number of trees (column 2, *stand table*) to give the volume of that diameter class (column 4, *stock table*). Although the method is arduous, particularly if a calculating machine is not used, the total volume of 20,395 cubic feet compares closely with the estimate of 20,251 cubic feet obtained in the single computation above. Note that Table 7 applies to red pine only while Table 6 contains the computations for all seven species in the same stand.

Merchantable volumes. — Both board-foot and cordwood volumes are derived from the cubic-volume estimates. For the average diameter of that portion of the stand for which the board-foot estimate is desired, the board foot-cubic foot ratio is obtained from Table 2. The mean d.b.h. of all the red pine in Table 5 is 12.8 inches, and the corresponding ratio is 5.8. The crude nature of the board-foot concept hardly justifies interpolation or carrying this factor to an additional place. The board-foot volume of the red pine is obtained by multiplying the total cubic-foot volume of 20,251 by the ratio of 5.8, yield-

TABLE 7.—CONVENTIONAL STOCK TABLE CONSTRUCTION
Itasca 5-acre plot, 130-year-old red pine

1 D.b.h.	2 N	3 Cf/Tree	4 Cf	5 Bf/Tree	6 Bf
5	22	1.5	33		
6	30	3.0	90	12	360
7	42	6.4	269	28	1,176
8	49	10.2	500	34	1,666
9	35	13.3	466	67	2,345
10	44	17.7	779	89	3,916
11	44	22.3	981	115	5,060
12	63	26.3	1,657	143	9,009
13	75	31.5	2,362	177	13,275
14	60	36.9	2,214	211	12,660
15	68	42.8	2,910	251	17,068
16	55	48.7	2,678	293	16,115
17	47	55.0	2,585	335	15,745
18	23	61.8	1,421	377	8,671
19	10	69.4	694	429	4,290
20	8	77.0	616	475	3,800
27	1	140.0	140	900	900
Total	676		20,395		116,056

ing a board-foot estimate 117,460. This compares closely with the conventionally derived estimate of 116,056 board feet, obtained the long way around in Table 7. The accuracy of the short-cut method becomes even more apparent when it is remembered that most actual scales overrun or underrun estimates of board-foot volume by a substantial percentage.

If desired, the board-foot estimate may be obtained for any diameter class or any grouping of diameter classes. Care must be taken to use a board foot-cubic foot ratio appropriate to the average diameter of the group being estimated.

Similarly, the cordwood estimate is derived from the cubic-foot estimate by choice of the appropriate converting factor. In Table 6, the cordwood is estimated for the pole timber only. This necessitates development of the mean diameter for that portion of the stand and the use of this value to obtain the correct converting factors for each species.

Finally, the stand (or condition class) values are summarized on a *per acre* basis. These values are obtained by multiplying the pertinent figures by the reciprocal of th acreage. The reciprocal is used because multiplication is a good deal faster than division on a fully-automatic calculating machine when multiplier remains constant and can be locked into the keyboard.

The *per acre* summary gives for each species and for the entire stand (1) the number of trees, (2) basal area, (3) mean diameter, (4) cubic-foot volume, (5) board-foot volume, and (6) cordwood volume. All of these values may be computed from the original stand table in just a few minutes by the use of the short-cut methods described and a fully automatic calculating machine. In contrast, more than 1 man-day was required with the test material for the calculation of the same values by conventional methods.

Growth Estimation by the Two-Way Method

The two-way method.—The two-way method of growth estimation was developed by the writer following a detailed study of existing growth estimation methods and an analysis of the variables associated with actual growth in permanent sample plots. It is discussed in detail in Chapter 22 of *Forest Inventory*.

In theory, this method rests upon the fact that growth in volume per unit area is a function of both growth in basal area and growth in height. If these can be estimated, an accurate estimate of volume growth per acre can be rapidly computed.

Growth in net basal area is largely a function of stand density. It may be derived from the growth in diameter obtained from increment cores. If all the trees in the stand are measured from increment cores, gross growth in basal area will be estimated with no provision being made for loss due to mortality. To obtain a net growth estimate, allowance must be made for expected mortality. Conventionally, this estimate is based either on trees that have died in the past 5 or 10 years or on trees that are expected to die within the next 5 or 10 years. A shortcut, satisfactory for healthy nonmature stands, however, is outlined in *Forest Inventory*. If the increment core sample is confined to the dominant and codominant stand (or alternatively to the largest 80 percent of the total number of trees in the stand), it can reasonably be assumed that growth and mortality will approximately balance out in the overtopped stand (or in the smallest 20 percent of the number of trees). Consequently, the gross growth in basal area of the dominant and codominant stand will approximate the net growth of the entire stand.

Growth in height is largely dependent upon stand age and upon site quality. It may be obtained, therefore, from conventional site index charts. Alternatively, it may be estimated from height growth curves based upon site quality (estimated on any valid basis) and present height (rather than age). This latter basis permits the application of the method to uneven-aged stands.

Of the conventional growth methods, the *yield table* method relies principally upon age and site index, but is based upon a highly theoretical and ephemeral *normal* stand and embodies only rough corrections for variations in stand density. *Stand table projection*, on the other hand, relies almost entirely upon diameter growth and ignores direct consideration of site quality and stand age. It involves a good deal of computation for its relatively low accuracy, and requires an adequate sample of cores in each diameter class rather than merely for the stand as a whole.

In contrast, the *two-way method* takes advantage of age and site-index information for estimating growth in height, and of increment core (or related experience table) data for estimating growth in basal area. It requires fewer cores than the stand table projection inasmuch as only the stand as a whole needs to be sampled—not each diameter class. Furthermore, it is much faster. It is apparently more accurate than either of the older methods and is applicable to a wider variety of stand condtions.

Data needed.—A good growth study will build upon the accompanying volume estimate. In the technique here proposed, all the necessary growth data are collected at the same time and for the same trees measured to evolve the local volume table. These measurements are recorded in Table 3. Increment cores are taken at breast height both to obtain past current increment and tree age. Bark thickness is read to the nearest twentieth-inch and is recorded without change of value as double bark thickness to the nearest tenth-inch (column 5). This value, subtracted from d.b.h. outside bark (column 4) gives present d.b.h. inside bark (column 6). Similarly, 10-year radial growth is measured to the nearest twentieth-inch and is then recorded without change of value as 10-year diameter growth to the

nearest tenth-inch (column 7). This value, subtracted from the DIB, gives the diameter inside bark 10 years ago (column 8). Note that the form is set up so that these diameters can be recorded on the original tally sheet.

The height measurements, previously used to develop local volume tables, are again used in the site-index determinations. Since site index is generally based on the average height of dominant and codominant trees, the heights of intermediate and suppressed trees in column 9 are bracketed and do not enter into the computation of mean stand height (93 feet).

Age is measured from the same core. The number of rings missed at the center is approximated. Thus, 170 + 2 indicated that 170 rings were counted and the center was missed by approximately 2 rings. When rot is encountered, the number of rings to rot is indicated (as 135 + R) and the rot diameter is recorded. The sum squares of the rot diameters, when compared to the sum squares of the DIB values, gives an estimate of the percent rot at breast height in the sample trees. For the trees listed in Table 3, the rot percent is determined by dividing 154 by 2,066. It is 7 percent. Such a factor is most useful in estimating cull when based upon a larger number of increment borings in a given stand or condition class. In determining the average age of the stand, these rotten cores are not considered and their age-counts are bracketed in column 10.

Other than the increment core data and the information of stand height and age obtained from the sample trees, the only other information needed for the growth estimate is the previously constructed volume estimate and adequate site-index (or other height-growth) curves.

Growth in height.—The stand able cited in Table 5 was developed from the 1948 measurements of a 5-acre sample plot in red pine. At this time, the stand was approximately 123 years old at breast-height. The dominant and codominant trees had an average height of 79 feet. Allowing 12 years on this poorer than average site for the pine to reach breast height (*Forest Inventory*, Fig. 20, p. 314), total age is estimated at 135 years.

Since the 1952 remeasurement of the same stand will provide a check on the two-way growth estimate, we wish to predict stand height for that year. Entering the values of 135 years and 79 feet in height in a site index chart for red pine (unpublished), estimated height of 80 feet is obtained for 1952. A similar estimate would be obtained from the yield table published by the Forest Service.[6]

Growth in basal area.—On the individual tree measurement sheet (Table 3), the sum of the squares are computed for the present d.b.h. (DBH), the present diameter inside bark (DIB), and for the diameter inside bark 10 years ago (dib).

Growth in basal area on a unit area basis may be calculated directly from the formula developed in *Forest Inventory:*

$$G_B = \frac{X^2\,(DIB^2 - dib^2)}{183.3465\,DIB^2}$$

This formula takes into account the effect of bark growth, the normal reduction of diameter growth as the tree enlarges, and any discrepancy between the average size of the sample trees and the average size of the trees in the stand being estimated.

In this formula, X^2 refers to the sum squares of the diameters in the dominant-codominant portion of the stand. In Table 5, the dominant-codominant portion of the stand is estimated to be the saw-timber portion. The sum squares for the red pine saw timber is 58,531 + 42,654 or 101,185. The other two values are obtained from the sum squares of columns 6 and 8 in Table 3. Were Table 3 developed from the same stand as Table 5, the value 2066 would be entered for ΣDIB^2; and 1910 would be entered for Σdib^2. In the solution below, values from increment cores taken in 30 trees chosen at random from the same 5-acre plot have been substituted for these unknown:

$$G_B = \frac{101{,}185\ (5871 - 5223)}{183.3465\ \cdot\ 5871}$$

With a fully automatic machine, this equation is quickly solved to give an estimate of basal area growth of 60.9 square feet for 5 acres over a 10-year period or 1.21 square feet per acre per year. Actual basal area growth of the red pine portion of this stand from 1948 to 1952 turned out to be 1.20 square feet per acre per year.

Growth in cubic-foot volume.—Once the growth in height and the growth in basal area have been estimated, the growth in cubic-foot volume is obtained on the assumption that the stand form-factor has not changed significantly over the period for which the short-term estimate is desired. Although the stand form factor (not to be confused with tree form class or form factor) does change with time in young stands, the effect of this change is very small compared to the accuracy of any growth estimate. Ordinary growth methods give a standard error of estimate of 25 percent or larger, while the two-way method cannot be expected to produce an error of less than 15 percent.

If the stand form factor is assumed to remain unchanged, then the percent relationship between (1) the product of basal area and height and (2) cubic-foot volume will hold for the future period. Expressed mathematically:

$$\frac{\text{Present } B \times \text{Present } H}{\text{Present } Cf} = \frac{\text{Future } B \times \text{Future } H}{\text{Future } Cf}$$

Substituting values obtained from the volume estimate and the estimates of growth in basal area and height, we obtain:

$$\frac{120.9 \times 79}{4050} = \frac{125.7 \times 80}{\text{Future } Cf}$$

The future cubic-foot volume is therefore estimated at 4,262 in 1952, giving a growth of 53 cubic feet per acre per year. This esti-

[6] Eyre, F. H., and Paul Zehngraff. Red pine management in Minnesota. U. S. Dept. Agric. Circ. 778. 70 pp. 1948.

mate compares with the actual volume of 4,271 cubic feet in 1952 and the actual 1948-1952 growth of 55 cubic feet per acre per year.

Growth in board-foot volume.—A generally satisfactory estimate of board-foot growth can be obtained by multiplying the cubic-foot growth by the present board foot ratio. Thus, multiplying 53 cubic feet per acre by the current ratio of 5.8, an estimate of 307 board feet per acre per year is obtained for the red pine saw timber on the 5-acre plot. This compares with the actual growth of 315 board feet per acre per year obtained from the recurrent cruise.

Actually, the board-foot growth will be slightly underestimated by this simple method as the mean diameter of the saw timber may be expected to increase, thereby increasing the future board foot-cubic foot ratio. Again, the increment borings may be drawn upon to estimate the growth in mean diameter of the stand. If we assume a 1 percent mortality each year in the number of trees, the 676 red pine found in 1948 may be expected to drop to 649 (130 per acre) in 1952. Dividing the estimated 1952 basal area (125.7) by this number, the basal area of the mean tree in 1952 is estimated to be 0.97 square feet, corresponding to a mean d.b.h. of 13.3 inches. The projected mean diameter of 13.3 inches gives a new board foot-cubic foot ratio of 5.83; and growth of 309 board feet of red pine per acre. It is questionable, however, whether the crudeness of the board-foot measure and the general low accuracy of growth methods justifies this nicety in calculating board-foot growth.

Summary

The above discussion is based upon the theory of volume and growth estimation as presented in *Forest Inventory*. By the proper choice of methods, and the proper use of fully automatic calculating machines, it is possible to set up inventory procedures so that office computations can be reduced to a minimum at the same time that volume and growth estimates of high precision are obtained. In particular, the use of the cubic-foot measure as the basic unit of volume, the volume-line method of constructing local volume solutions based on d.b.h. alone, and the two-way method of growth prediction are recommended for their simplicity, accuracy, and adaptability to fast calculating machine techniques.

State Foresters Elect New Officers

The Association of State Foresters met October 5-7 in New Hampshire and elected current officers as follows: president, C. Huxley Coulter, Florida state forester; vice president, A. D. Nutting, forest commissioner, Maine; secretary-treasurer, L. T. Webster, supervisor, Division of Forestry, State of Washington. George S. McIntire, Michigan Forestry Division chief, and retiring president, George O. White, state forester of Missouri, will serve on the executive committee.

Surface Runoff and Erosion from Pine Grasslands of the Colorado Front Range[1]

E. G. Dunford[2]
U. S. Forest Service, Pacific Northwest Forest and Range Experiment Station, formerly with Rocky Mountain Forest and Range Experiment Station.

IN THE Colorado Front Range, intensity of land use must be gaged with special care to maintain acceptable watershed conditions. Sparse cover, unstable soils, and intense summer rains compound the difficulties characterizing multiple-use management. Water from the Front Range is acutely needed in the adjacent Great Plains, but its quality and regularity of flow have long since been impaired by heavy grazing and unrestricted timber cutting. While such activities can very likely be continued at a reduced scale, it is important to establish the limits dictated by good watershed management. A measure of these limits is being obtained from two small studies, described herein, which concern the influence of cattle grazing and timberland disturbance on runoff and erosion.

Characteristics of the Front Range

The Colorado Front Range is formed by the lower mountains and foothills between 6,000 and 9 000 feet elevation on the east flank of the Continental Divide. The area receives an average of 10 to 20 inches of precipitation annually, the bulk of which results from summer convectional storms. In general, the soil is relatively permeable, but it erodes easily under abuse. Recovery of protective vegetation is very slow, particularly on south slopes.

Vegetative cover consists largely of timber and grass. In a considerable portion of the area, bunchgrass is found in mixture with ponderosa pine and in open valleys, parks, and meadows. Grass cover varies in density, depending on the site, from relatively lush meadow lands to extremely thin and patchy cover on steep, unstable south slopes. The latter condition is common in the Front Range, especially on soil developed from Pikes Peak granite. Best grazing sites are the small, bunchgrass openings dotted through open-growing pine and in broader parklike areas, swales, and lower alluvial benches. Some grazing is provided throughout, except on north-facing slopes where denser mixtures of Douglas-fir and pine prevail.

Timber cutting for lumber, ties, mine props, poles, and posts has been going on for more than 75 years. Commercially valuable tree species are ponderosa and lodgepole pine, Douglas-fir, and some Engelmann spruce. Today, much of the forest cover is a residual of old growth passed over in earlier cuttings, mixed with patchy stands of second growth. Aspen is an important component in many young stands, particularly where fire has occurred.

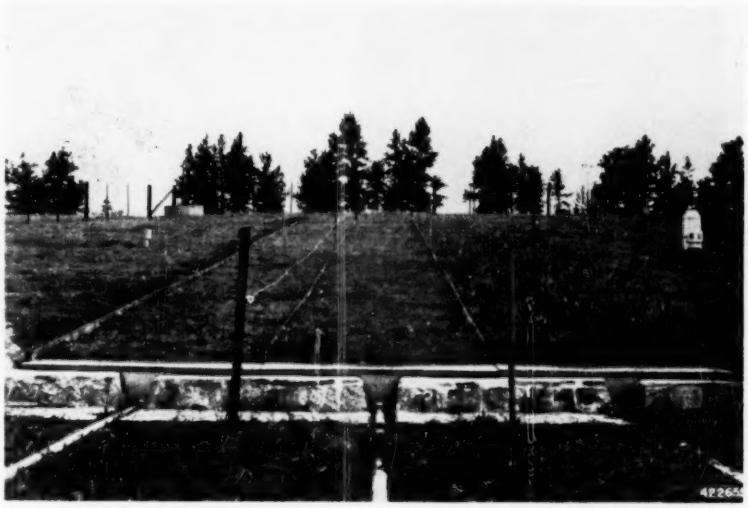

FIG. 1.—Bunchgrass plots (block A) after grazing by cattle. Grazing intensities from left to right (plots 1 to 3) are: heavy, moderate, and none. August 1942.
Photo U.S. Forest Service

The Experiment

The study is being conducted at Manitou Experimental Forest in the Pikes Peak region near Colorado Springs. Runoff and erosion have been measured from six 1/100-acre plots in the bunchgrass type since 1937. The object is to determine how two different degrees of grazing use affect amounts of surface water flow and the quantity of soil moved by erosion. Similar measurements were begun a year later in young ponderosa pine. In this case the object is to determine the runoff and erosion resulting from removal of the protective forest floor, as in a ground fire, and later from complete elimination of the tree cover.

The two study sites were chosen to avoid major differences other than cover. They are located about a half mile apart on an alluvial bench characterized by a relatively permeable soil. Both are on 17.5 percent slopes with north exposures, and at practically identical elevation—7,600 feet. A tension zone between trees and grass appears to exist locally at this elevation, characterized by fingers of

[1]Paper presented at the joint meeting of the Divisions of Watershed Management and Range Management, Society of American Foresters, Colorado Springs, Colo., September 1953.

[2]The author wishes to acknowledge the contribution to the planning and supervision of this study made by W. M. Johnson, officer in charge of Manitou Experimental Forest, and to T. W. Hansen for faithful collection of records since 1946.

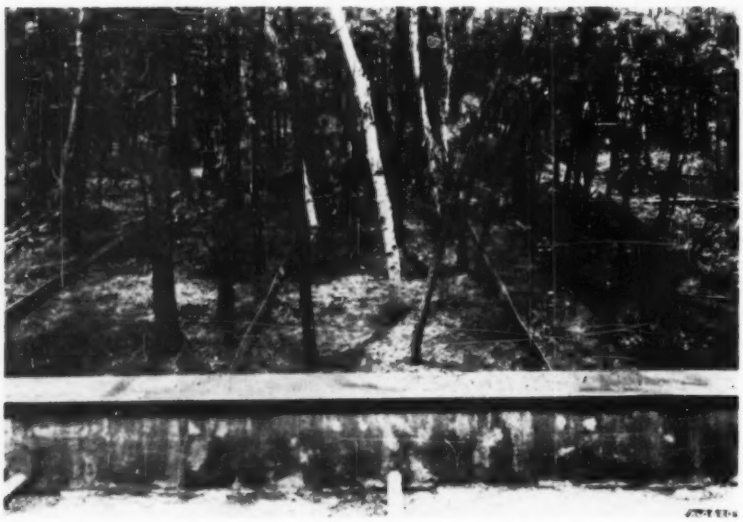

FIG. 2.—Ponderosa pine plots in block B after removal of litter. June 1941. *Photo U.S. Forest Service*

open grassland extending into the lower limits of tree growth and intermixing with the more open-grown timber stands. On the bunchgrass site, the principal species are Arizona fescue, mountain muhly, sedge, and associated miscellaneous grasses and weeds. The timbered site is covered with a dense stand of sapling ponderosa pine with a scattered mixture of aspen but virtually no grass.

At both installations, surface runoff and eroded material are measured from six plots numbered consecutively from east to west and divided into two blocks of three each. A distance of approximately 15 feet separates block A (plots 1, 2, and 3) from block B (plots 4, 5, and 6). Plot boundaries are sheet metal baffles measuring 6.6 x 69 feet, and enclosing a projected horizontal area of 1/100 acre. A catchment trough is fitted at the bottom of each plot from which the surface runoff and eroded material drain into a silt tank. Baffles are provided in the silt tank to help settle out the fine soil particles, and any overflow water thus cleared of sediment drains off into collector tanks.

Three basic types of data are recorded: precipitation and surface runoff in inches and eroded material in pounds per acre. Precipitation is measured in standard 8-inch-diameter cans and also in recording gages, which give additional information regarding time of occurrence and intensity of storms. Runoff is measured in both the silt tanks and collector tanks after each storm of sufficient size to produce overland flow and converted to inches depth over the plot delivering it. Eroded material is collected, air-dried, weighed, and expressed as pounds air-dry weight per acre. Both runoff and erosion have been used in this study to gage the effect of treatment.

Precipitation, measured at the bunchgrass site since 1937, has been somewhat variable, ranging in yearly totals from 7.6 inches in 1939 to 24.0 inches in 1947. The average for the period has been 15.6 inches. Approximately 10 inches, or about two-thirds of the yearly total, is in the form of rain. Winter precipitation is very light but comes entirely as snow. That which arrives in April, May, September, and October can be either snow or rain. July and August are the peak months. High-intensity storms producing runoff and erosion occur most frequently during this 2-month period, but also have been recorded during all months from May to September, inclusive. It is common for intensities to reach 3 inches per hour for 5-minute periods, but storms exceeding 4 inches per hour are a rare occurrence.

Supplementary records taken at the ponderosa pine plots substantiate the general trends found at the bunchgrass plots. Slightly more precipitation was received; an average yearly gross catch of 17.0 inches was recorded for the years 1939 through 1952. Net rainfall under the trees, measured by stationary gages at the four corners of the installation, showed an average catch of 13.8 inches or 81 percent of gross.

Both experimental areas were fenced and protected from livestock disturbance between time of installation and the application of the first treatments in 1941. A period of nonuse was necessary to detect inherent plot differences which might obscure the effects of applied treatments.

Bunchgrass Study.— Prior to installation of the bunchgrass plots in 1937, cattle had grazed the area during winter and spring months. Density studies, made on the plots from 1937 to 1941 while they were ungrazed, showed an average plant cover of 14.5 percent. Densities for individual years ranged from 8 percent to 23.6 percent, varying with annual precipitation.

During this calibration period, precipitation, runoff, and erosion were also measured and following the 1940 rainfall season, the data were analyzed to determine readiness for treatment. Statistical analysis indicated no real difference in runoff from individual plots within blocks, but real differences between the two blocks appeared to exist. Accordingly, identical sets of treatments were assigned to both blocks and randomized among plots within them.

The treatments, first applied in July and August of 1941, consisted of hand-clipping all the vegetation on four of the plots, leaving two unclipped as checks. Heavy grazing (2½ acres per cow-month) was simulated by hand-clipping and removing all vegetation down to an inch above the root crown on plot 1 (block A) and plot 6 (block B). Plots 2 and 4 were clipped leaving 2 inches to represent moderate grazing (4 acres per cow-month),

and no clipping was done on plots 3 and 5. Weight of the grass and weeds removed from the heavily clipped plots averaged 863 pounds per acre while moderate clipping produced 536 pounds per acre on an air-dry basis.

Following the 1941 season, it became apparent that the absence of trampling was a serious drawback in hand-clipping and that more usable and reliable results would be gained from actual grazing by cattle. Difficulties in obtaining the desired grazing intensities were foreseen, but very satisfactory control was achieved by using movable electric fence (Fig. 1). Grazing has been continued annually by using cattle for a duration of 3 to 5 days, once during each summer season.

Grazing intensity is judged by eye, based on standards derived from experience with controlled grazing in associated management studies.[3] Moderate grazing in the bunchgrass type results in the utilization of 30 to 40 percent of the herbage, whereas for heavy grazing, utilization is 60 to 75 percent. Stubble height of the key species—Arizona fescue and mountain muhly—provides a reliable indicator of utilization.

Ponderosa Pine Study.—After a calibration period ending in 1940, data from the ponderosa pine installation were subjected to an analysis similar to that in the bunchgrass study. Differences in the average runoff between the two blocks proved to be nonsignificant, indicating that a treatment could be assigned at random to either. This was done in June 1941; needle litter was removed from the ground surface of all three plots in block B, simulating the effects of a ground fire (Fig. 2). Material removed included all organic material not incorporated into the A_1 horizon. The treatment was not varied among the three plots because results would likely have been partially obscured by border influence, particularly as the result of interlacing tree crowns. In contrast to the bunchgrass study, where plots were the sampling unit, the evaluation of the ponderosa pine treatments is based on the differences between blocks A and B.

A second treatment was applied to block B in July 1952. This time the overstory of trees, as well as the litter which had accumulated since 1941, was removed. A border strip approximately 6 feet in width around the edges of the block was also cleared.

[3]Johnson, W. M. Effect of grazing intensity upon vegetation and cattle gains on ponderosa pine-bunch grass ranges of the Front Range of Colorado. U. S. Dept. Agric. Circ. 929. 1953.

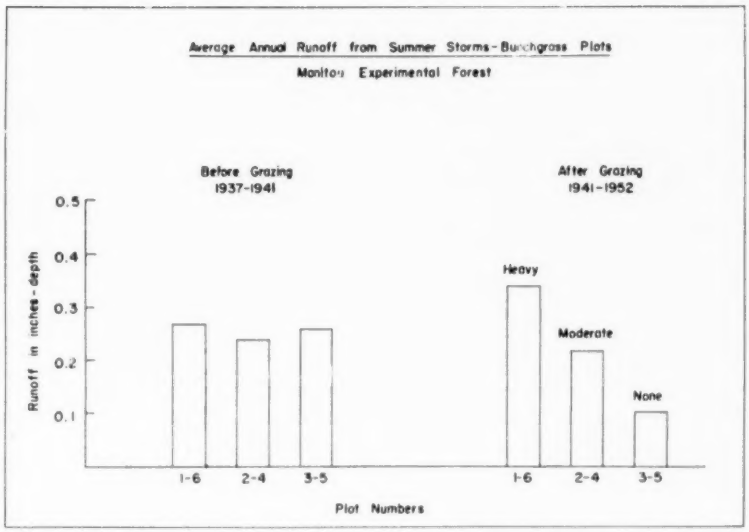

FIG. 3.—Average seasonal runoff in inches depth from summer storms before and after grazing treatment.

Results from the Bunchgrass Plots

An analysis of runoff on the untreated check plots for the entire 16 years shows that individual summer storms producing measurable surface runoff occur on the average of four to five times per year. In addition, a portion of the annual runoff is credited to spring snowmelt. Runoff from snowmelt is not strongly influenced by relative amounts of cover on the plots because drifting of the snow pack

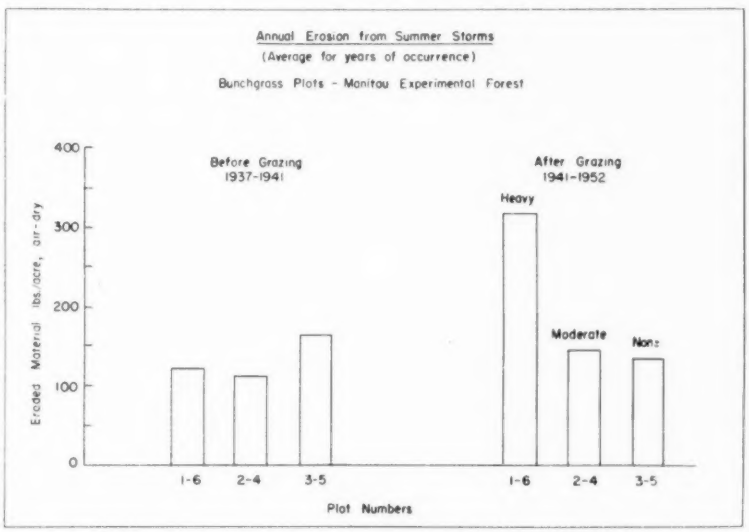

FIG. 4.—Erosion from summer rainfall, averaged for seasons of occurrence, before and after grazing treatment.

TABLE 1.—AVERAGE SURFACE RUNOFF PER SEASON IN INCHES DEPTH FROM PONDEROSA PINE PLOTS RESULTING FROM REMOVAL OF LITTER IN 1941 AND TREES AND LITTER IN 1952

Year and treatment	No. of storms causing runoff	Av. seasonal runoff in inches		Ratio Blocks B/A
		Block A	Block B	
Before treatment:		Untreated	Untreated	
1938	13	0.17	0.10	0.6
1939	13	0.05	0.04	0.8
1940	3	0.06	0.05	0.8
After removal of litter:		Untreated	Treated	
1941	14	0.17	1.17	6.9
1942	9	0.12	0.43	3.6
1943	6	0.06	0.20	3.3
1944	8	0.31	0.65	2.1
1945	12	0.59	1.05	1.8
1946	6	0.10	0.11	1.1
1947	13	0.23	0.36	1.6
1948	6	0.07	0.06	0.9
1949	10	0.10	0.07	0.7
1950	3	0.02	0.02	1.0
1951	1	Trace	Trace	—
After removal of trees & litter:		Untreated	Treated	
1952	3	0.03	0.49	16.3

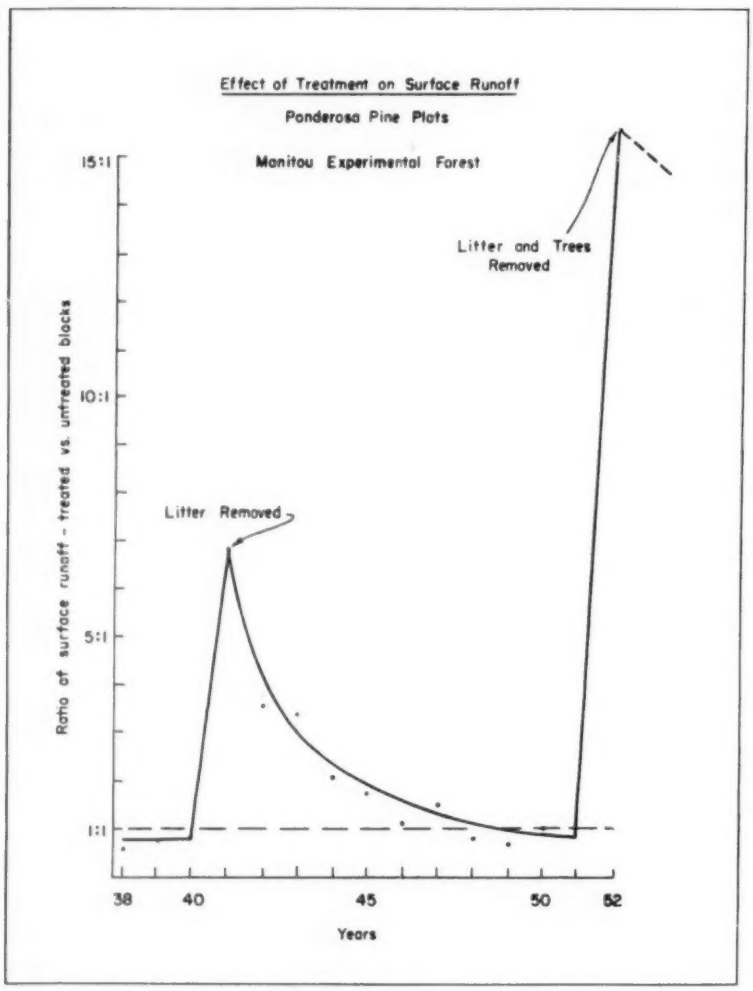

FIG. 5—Plotted ratios showing relation of surface runoff from treated and untreated blocks.

tends to obscure the results. On the other hand, runoff occurring during the months of June through September results from individual rain storms and responds to variations in cover treatment.

The influence of grazing on runoff during these four summer months is shown graphically in Figure 3. In the period before grazing, the average runoff varied from .24 to .27 inch. These plot differences were not statistically significant but soon became so following treatment as average amounts of runoff began to reflect variations in grazing intensity. In twelve years, the heavily grazed plots have yielded an average of .34 inch of runoff per season; moderately grazed, .22 inch; and nongrazed, .11 inch per season.

Grazing has also caused an increase in erosion, but not in direct proportion to intensity of use. During the calibration period, while there was no grazing by livestock, erosion occurred as the result of four separate storms occurring in three summer seasons. Average annual erosion for seasons of occurrence, as shown in Figure 4, ranged from 111 pounds per acre to 163 pounds per acre. Following the initiation of grazing treatment, 13 storms were of sufficient size to produce erosion. Average annual depositions for seasons of occurrence were 134, 145, and 316 pounds per acre, respectively, for none, moderate, and heavy grazing. A significant increase in erosion has resulted from heavy grazing while erosion from moderately grazed plots remains near normal. In 8 of the 16 years of study, there has been no measurable erosion. Months of greatest soil movement, as might be expected, were July and August. It was noted, particularly in 1938, 1944, and 1945, that erosion tended to occur during periods when large storms follow one another at short intervals.

Results from Ponderosa Pine Plots

Both treatments in the ponderosa pine plots produced striking increases in runoff and erosion. Prior

to disturbance, no erosion occurred through three summer seasons. In the summer of 1941 following removal of needle litter in June, three storms were of sufficient size to cause soil movement. The three plots in the treated block yielded an average of 76.1 pounds of air-dry eroded material, almost 4 tons per acre, while the untreated block yielded none. During the period June through September, in the years 1941 to 1945 inclusive, erosion resulted from 14 storms, but at a steadily decreasing rate. In these five years, the amount of air-dry eroded material derived from the treated plots decreased from 25.4 to 1.0 pounds per storm. No erosion occurred from 1946 through 1952, and it was concluded that the effect of litter removal in 1941 had been virtually eliminated by the gradual return of a ground cover.

The second treatment—removal of trees as well as the litter cover—was applied to the same block in July 1952. Again, erosion resulted from the next heavy rains while the undisturbed block produced none. Three storms during the remainder of the summer season produced an average of 89.5 pounds of air-dry eroded material per plot—more than 4 tons per acre.

The response in surface runoff was equally impressive. Influence of litter and tree removal is depicted by the ratios of runoff from treated and untreated blocks in Table 1 and Figure 5. Prior to disturbance, no significant differences existed. During the 1941 summer period following removal of the litter layer, runoff produced from the treated block was 6.9 times that of the untreated. In subsequent years, runoff from the two blocks returned to an approximate equilibrium. Following the second treatment in July 1952, a differential in runoff between blocks occurred again, with the ratio this time reaching 16.3 to 1. Since tree cover was also removed in this instance, surface runoff is expected to remain at an abnormal level for a considerably longer period.

Discussion

These two studies were designed to examine the results of grazing and forest disturbances on runoff and erosion. The objective has been to establish limits on the intensity of such uses in Front Range watersheds.

From the bunchgrass study, it is possible to develop some standards for management of Front Range grazing lands. Heavy grazing (2½ acres per cow-month) appears to go beyond the limits allowable in good watershed management practice. Erosion has begun to accelerate above a rate which can be regarded as normal. In addition, surface runoff has increased and less water enters the soil reservoir where it could be available for plant growth or subsurface supply for regulated streamflow. Erosion does not appear to be substantially increased as a result of moderate grazing (4 acres per cow-month) in spite of some additions to surface flow. In practice, it appears that moderate grazing on relatively gentle slopes is permissible if the increased loss of runoff water does not cause critical shortages of moisture for plant development.

These observations have been partially substantiated by a large-scale pasture study being conducted in the same general area.[4] Here, similar grass cover has been subjected to three rates of grazing—light, moderate, and heavy—since 1942. Moderate grazing has proved to be the most efficient from the standpoint of economic returns in beef production. Furthermore, moderately grazed pastures are holding their own in annual forage production, plant vigor, and density.

Results of treatment in the ponderosa pine plots show the tenuous protection supplied by forest cover in Front Range watersheds. Complete removal of litter, as may occur from ground fire, brings immediate response in terms of flashier runoff and greatly increased erosion. Clearcutting accompanied by removal of the protective litter simply increases the effect by removing the sheltering overstory. This suggests that timber, even on moderate slopes in the Front Range, should be lightly cut by a single-tree system of selection and harvested with great care. Fire and other forms of widespread ground disturbance should be eliminated entirely.

[4] Op. cit.

Soils and Forest Tree Breeding[1]

S. A. Wilde[2]
Professor of soils, University of Wisconsin, Madison.

FOREST TREE BREEDING is a young, but vigorous branch of applied science. It was fortunate to acquire from its parent disciplines the theoretical foundations of genetics and the practical knowledge of selection and hybridization techniques. Thus richly endowed, forest tree breeding has already accomplished feats that have roused the admiration of plant specialists. It is sufficient to mention hybrid poplars producing a harvest of pulpwood at the infantile age of 15 years. Yet, in spite of these successes, forest tree breeding like many "prodigy children" is not free from a danger of a delayed or even an arrested maturity.

A sound development in any realm of life is the outcome of the nature as well as the nurture of specimens; a close correlation of the inherited growth potential with suitable environmental conditions. Thus far forest tree breeders have fulfilled the latter requirement only in regard to climatic influences, but they have neglected the equally important effects of soil factors. With rare exceptions, forest soils specialists are also to be blamed for the existing shortcomings, since they paid little attention to the problems of forest genetics. However, the increased interest of reforestation practice in genetically superior stock will doubtlessly force both groups of technicians to abandon their attitude of isolationism and solve acute problems by cooperative efforts.

This paper is limited in its scope to the phases of tree selection and breeding in which soil may play an important part either as a factor determining the hereditary properties of trees, or as a medium for the growth of breeding material and superior progeny. The following aspects are given particular attention: (1) soil as a selective agent; (2) selection of superior trees; (3) progeny tests, establishment of seed orchards, and maintenance of genetical arboreta; (4) development of hybrids; (5) reforestation with elite, pure clone, or hybrid stock.

Soil as a Factor in Natural Selection

Numerous observations have proved that climatic conditions influence the course of natural selection and the inherent growth potential of trees. This influence is so pronounced that in some instances it affects the forest economy of extensive regions and calls for an artificial replacement of the natural stands by the introduced trees. According to ideas of some forest geneticists, the productive capacity of southern Sweden would be considerably increased by a replacement of the slowly growing native variety of *Picea abies* by the rapidly growing German variety of the same species (*5*).

Contrary to this clear-cut picture of climatic influences, there is only fragmentary and rather vague information on the selective effects of the soil. A few observations suggest that forest stands confined to certain soil types undergo natural selection, as a result of which the surviving population consists of individuals whose genetic constitution permits them to cope with a shortage of moisture and nutrients, high concentration of salts, or other adverse conditions. Such a process, of course, can take place only when forest stands occupy an area of soil large enough to exclude pollination from trees growing on soils of different composition. The progeny of phenotypically inferior or dwarfed trees, located on small areas of infertile soils, such as calcareous outcrops, was often found to regain its good hereditary form and high growth potential when planted on reasonably favorable sites (*19*).

The most often quoted example of presumably selective influence of the soil on trees is presented by the deformed and slowly growing Scotch pine stands on hardpan podzols of Germany (*14*). These stands have fallen into ill repute throughout the silvicultural world because of the inferior quality of their progeny, living witnesses of which can be observed in many places of Europe as well as America. Climatic conditions of German podzols are not greatly different from those of the Riga region of Latvia which produces one of the best genetical varieties of Scotch pine. Therefore, it may be assumed that the inferior quality of German stands has resulted from the highly unfavorable conditions of moisture, characteristic of hardpan podzol soils. Such conditions are likely to encourage the survival of the drought-resistant but slowly growing trees. This tendency would be especially probable because of a shallow penetration of the pine root systems, arrested in their development by the hardpan layer.

A more convincing illustration of the selective influence of the soil is provided by halophytic woody plants, especially *Betula kirghisorum* and *Arthrophytum haloxylon*. These trees of desert and solonchak soils tolerate enormously high concentrations of salts and do not change their inherent morphological and physiological characteristics when transplanted on alkali-free soils; in fact, they do not grow satisfactorily on soils with a normal electrolyte content (*15*).

A study in Wisconsin (*25*) has indicated that the seed of jack pine and red pine originated on sand

[1]Contribution from the Soils Department, Wisconsin Agric. Expt. Sta., Madison, in cooperation with Wisconsin Conservation Department.

[2]The writer expresses his appreciation to Drs. G. K. Voight and J. J. Curtis, University of Wisconsin, for their help in the preparation of this report. He owes a debt of gratitude to Dr. F. I. Righter, U.S.F.S. Institute of Forest Genetics, for his review of the manuscript and a number of elucidative comments which helped to coordinate the pedological and the genetical viewpoints. Valuable suggestions were received from Dean Hardy L. Shirley, State University of New York College of Forestry, and Paul O. Rudolph, Lake States Forest Experiment Station.

dunes produces seedlings of a much slower inherent rate of growth than the seed originated on granitic outwash and other fertile soils. The deficiency of moisture and nutrients in these aeolian deposits may be suspected as a factor precluding survival of specimens of high growth potential. The same study, however, failed to reveal any relationship between the site quality of parent white pine and the growth of the progeny. Perhaps the diminutive and frugal varieties of white pine are not developed by natural selection because this semitolerant and rather exacting species is incapable of competing with the pioneer forest cover on poor soils.

The results of the geographic-origin tests led Wright (*24*) to conclude that "In general, the races from regions whose climate and soils favor rapid growth, good form, or a high degree of cold resistance exhibit these same characters when grown in comparison with other races under uniform conditions."

There is a notion among foresters that the seed of redcedar originated on acid soils does not produce seedlings suitable for reforestation of alkaline soils, and vice versa. A failure of several red pine plantations on sandy soils of Wisconsin was attributed by some to the origin of planting stock raised from the seed collected on rich lacustrine clays. A marked difference in the inherent rate of growth of black spruce nursery stock raised from a seed collected in muskegs and on upland soils of Minnesota was observed by the author. The validity of these observations is now being investigated by greenhouse and field trials.

Selection of Plus Trees

No matter how speculative certain claims and conclusions in regard to the selective effects of the soil may be, they cannot be discarded by silviculturists without a reasonable proof of their total unreliability. For this reason, it seems to be desirable to consider the following restrictions in the choice of superior trees to serve as a source of seed or breeding material:

(a) As a general policy, it is advisable to avoid too great differences in the composition of soils supporting parent trees and soils to be reforested. The origin of the soil, textural and structural composition of the soil profile, position of the ground water table, pH value of the soil, content of carbonates, and supply of essential nutrients appear to be among characteristics to receive particular attention.

(b) In reforestation of sites subject to drought or winter kill, selected or hybrid stock should not be originated from the fast growing elite parent trees developed under optimum conditions of soil fertility. Such stock with its hereditary high rate of transpiration may be the least capable of surviving under conditions of either summer or winter deficiency of water.

(c) In securing planting stock for lands where frost injury may be expected, attention should be given to trees growing on gley soils of lowlands. In the regions of low temperatures, stands on such soils are exposed to severe frost damages. Thus, in consequence of natural selection, late flowering varieties are developed which are more resistant to spring frosts (*16*).

These tentative suggestions are made in the spirit of the ideas expressed by one geneticist (*2*): "The forest tree breeder must admit the factor of the unforeseen into his consciousness, absorb it into thinking, and establish it as one of the guiding principles in making plans. He must prepare for a contest in which the rules may change as the game progresses."

In the initial stages of a selection program, it should be remembered that genetically inferior trees growing on fertile soils may have a much better appearance than genetically superior trees growing on soils of low fertility (*10*). Therefore, the choice of plus trees, i.e. potential elite trees, for breeding cannot be accomplished too efficiently without an appraisal of the soil productive capacity.

In certain geological formations, e.g. in terminal moraines, the composition of the soil profile often changes within short distances. Therefore, the determination of soil influences may at times require many profile excavations. The local modifications in the soil productivity may be caused by the occurrence of a perched water table, irregular extensions of the capillary fringe, seepage, pockets of sand or clay, intrusions of lime or other petrographic material, cementation or compaction of soil, and protrusion of rock substrata.

Progeny Tests, Establishment of Seed Orchards, and Maintenance of Genetical Arboreta

The genetic quality of the selected phenotypically superior trees is determined by planting their seed, grafts, or cuttings on testing areas and observing the growth of progeny or clones. This basically sound procedure may provide a totally misleading answer if trials are not conducted on a soil with a balanced and uniform fertility. The local variation in soil fertility may enhance the growth of inferior progeny and depress the growth of superior progeny. A deficiency of certain nutrient elements will render the trials meaningless. The discrepancies in the state of soil fertility may influence the growth of tested plants either directly or through the mycorrhizal fungi; the role of the latter organisms is of particular importance in work with cuttings, except those of the Populus genus.

Everything considered, it is best to conduct progeny tests on recently cleared forest land whose soil satisfies the requirements of species being investigated. The uniformity of the soil on such a testing ground should be carefully checked by field examination and by analyses.

If suitable recently cleared soils are inaccessible, fertility of the soil selected for progeny tests should be adjusted by available proce-

dures (*21*). Such an adjustment may not duplicate the composition of the virgin soils in all details, but, as nursery experiences have demonstrated, it will make possible normal and uniform development of the tested progeny. It is also advisable to verify that the soil of the area assures a normal development of mycorrhizae (*12*).

The superior offsprings, developed through progeny tests and controlled pollination, are planted in orchards to serve as a source of seed. Even though soil conditions cannot influence the hereditary characteristics of these genetically superior trees, unfavorable physical properties of the soil and unbalanced fertility will hinder the production of seed and may even lead to the deterioration of valuable clones. Therefore, the soils of seed orchards require the same careful attention as those of the progeny testing areas.

The arboreta are established to provide material of native and exotic tree species and varieties for breeding purposes. The value of such arboreta depends not only on the survival of the assembled forms, but also on their flowering capacity. Since different tree species, e.g. pines and spruce, have vastly different soil requirements, genetical arboretum must consist of either a number of areas of suitable soils, or a section of land including a wide range of soil types. The care devoted to the selection of the right kind of soils will greatly facilitate the establishment and performance, especially flowering, of breeding material. The need for a periodic adjustment of soil fertility or other soil-improving measures in genetical arboreta is not excluded.

Development of Hybrids

The achievements of agronomists and horticulturists in plant breeding suggest that this field offers a possibility of similar improvements in silvicultural crops. This may be particularly true when the program of tree breeding stresses the improvement of the form of trees or their resistance to climatic extremes and harmful organisms (*11, 17*). On the other hand, production of tree hybrids for the sole purpose of achieving exceptionally high yields is likely to present many difficulties. As a general rule, an inherently high rate of growth calls for a higher supply of available water and amplifies the vulnerability of trees to drought, frost, and winter kill; rapidly growing trees are less resistant to wind, sleet, and snow press. Thus, in certain respects, aims of tree breeding may sharply conflict with silvicultural philosophy which stresses the vigor of artificially created forests.

Side by side with highly promising successes, cultivation of hybrids, particularly those of the Populus genus, has met with discouraging failures, caused largely by the unfortunate choice of breeding material and the ecological misplacement of plantations (*3, 13*). In the opinion of Hautzagers (*4*), a noted Dutch poplar breeder, "indication given us by the hybridization work performed till now is that it is better, in general, to use pure species than hybrids." This is a rather startling statement at the time of a general enthusiasm for rapidly growing hybrid poplars. However, it is possible that Dr. Hautzagers' pessimism originates in part from the incorrect appraisal of the site requirements of the parent trees and their progeny. He believes, for example, that "*Populus grandidentata* grows in its natural habitat on somewhat drier soils than those preferred by *P. tremuloides* and is also less exacting as to soil fertility, so that this species in particular will be drawn into our work" (*4*).

Largetooth aspen is a species that definitely deserves the attention of forest geneticists, and perhaps it has certain ecological varieties of modest site requirements. In general, however, it is considerably more shade tolerant than trembling aspen, more vulnerable to drought, and has a definitely higher requirement for nutrients (*22*).

This difference of opinion suggests a more careful evaluation of site requirements of parent trees and selection of ecologically suitable breeding stock. In turn this may facilitate the production of hybrids better equipped to meet the rigid requirements of cut-over lands.

It should be mentioned that the amazingly rapid growth of poplars, ornamenting highways or serving as windbreaks, gives no clue either to the site requirements of such trees or fertility level of soils that support them. Such trees are growing without competition and extend their root system to a distance of nearly 200 feet to secure water and nutrients. It is equally dangerous to draw conclusions in regard to reforestation possibilities of hybrids of Populus or other genera on the basis of observation of stands growing on heavy soils in the drought- and frost-free oceanic climate of the Low Countries, France, Italy, or southern U.S.A.

As suggested by Brink (*2*), the adaptability of hybrids to certain soil conditions may be increased by the use of augmentive breeding. Michurin (*8*) attributed the success of his work on the development of tree hybrids to the careful attention he paid to the soil as a factor in plant breeding. Unfortunately, the observations of this plant breeder of the Burbank School are confined largely to the horticultural plants, and it is difficult to decide how far they may be applicable to forest trees. Keller maintains afforestation of prairie and alkali soils requires special selection of parent trees and sometimes breeding of stock which could "convert to its benefit the hostile forces of nature." As an illustration of a success of such an endeavor, Keller mentions the succulent and salt-resistant variety of grape, cultivated on alkaline soils of the shores of the Black Sea (*15*).

The development of the hybrids may gain certain improvements if their vigor is systematically evaluated by analytical methods devised by Langlet (*6*), Meuli and Shirley (*1*), and many agricultural breeders. A comprehensive bibliography dealing with the immunity and

general vigor of originated strains, as well as the analytical appraisal of these characteristics, is assembled in the English edition of Vavilov's book (*18*). As suggested by Mirov (*9*), physiological analyses may be of help in the determination of the ecological characteristics of parent trees and facilitate the development of genotypes suitable to a given set of climatic and soil conditions. Physiological grading of nursery stock was emphasized by Wakely (*20*), and the technique of physiological analysis of tree seedlings was reported by Wilde, et al. (*23*).

Establishment of Plantations of Elite, Pure Clone, or Hybrid Stock

Trees with their mycorrhizal symbionts have an enormous capacity for utilization of water and nutrients; some tree species produce high yields on rock outcrops by utilizing water of condensation and nutrients from unweathered minerals. Yet, like any other organisms, trees cannot cope with a critical deficiency of either water or nutrients, and silviculture has shown in the past beyond any shadow of a doubt that success of reforestation depends upon selection of suitable planting sites. These experiences were gained with planting stock of an average growth potential. The use of stock of a high growth potential, originated through selection or breeding, will considerably raise the standards in the choice of soils suitable for tree planting. In this regard, there is no difference between forest and farm crops, and as correctly stated by Albrecht (*1*), "One thing is sure—greater yields require greater quantities of plant food. The farmer switching to improved high-yielding varieties must of necessity use more fertilizer to gain the maximum advantage of the hereditary potential of the new strain."

Thus the utilization of the hereditary vigor of trees will require soils with an increased content of mineral colloids, organic matter, and nutrients; very likely it will impose more restricted ranges of soil reaction, a factor which influences the availability of nutrients; it will place greater demands upon permeability of soils, their water-holding capacity, and aeration.

Therefore, unless the reforestation program is ready to provide soils of a reasonable fertility, rapidly growing varieties are likely to suffer losses from drought and frost, and to increase the area of struggling non-merchantable plantations that may serve as breeding centers for parasites.

These are the reasons why enormous areas of land now in need of tree planting will not be suitable for reforestation with rapidly growing varieties of trees. Such lands include coarse siliceous sandy soils, moisture-deficient soils of the prairie-forest and desert-forest transitions, soils depleted by repeated fires and prolonged cultivation or grazing, and podzolized soils of lateritic substrata, impoverished in nutrients by abundant rainfall and man's mistreatment. On all such lands, the genetically superior nursery stock may become ecologically inferior planting material.

Perhaps, in some instances, the use of rapidly growing strains on infertile soils will be possible with the help of artificial fertilization. As a rule, however, such practice will have to be confined to soils underlain by a ground water, soils influenced by an extended capillary fringe, and soils of humid regions, e.g., those of the Atlantic Coastal Plain. Attempts to force the growth of trees by application of mineral fertilizers on soils deficient in moisture will only speed up the destruction of plantations by drought or frost.

The failure to realize that soil is an essential factor in the propagation of the superior tree strains, will not benefit either the forestry enterprise or commercialized forest genetics. As stated by Theodosius Dobzhansky, an authority on genetics, "The so-called nature-nurture problem is not to distinguish which traits are genotypic and which environmental, for all traits are genotypic and environmental." The refusal of a certain brand of Lamarckists to acknowledge the basic principles of heredity has brought to life the incredible "genetic controversy" which costs the world many square miles of pulpwood stands, wasted in futile polemics. A neglect of soil and other ecological factors in forest tree breeding program will only serve to perpetuate and amplify the existing fallacies, and to increase the aimless juggling of plant forms whose rapid growth, or even survival, depends upon the greenhouse-like environment of the propagation ground.

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Harvard Announces Fellowships in Silvicultural Research

Harvard University announces the Richard Thornton Fisher Research Fellowships designed to encourage study and research in silviculture. Two fellowships with fixed stipends of $2,000 each are available for the year 1955-56. They are to defray the expenses of tuition, living, and incidental travel for a period of approximately 15 months. The fellowships will enable students to matriculate in the Harvard Graduate School of Arts and Sciences, and to satisfy residence requirements toward a master's degree with work in forestry and silvicultural problems, or toward a doctor's degree in biology with particular reference to silvicultural problems.

The fellowships are open to those who hold bachelor's degrees from undergraduate schools of forestry or from colleges of liberal arts. Graduates of the latter schools must have majored in biological science.

Applications must be filed with the Graduate School of Arts and Sciences, 24 Quincy Street, Cambridge 38, Mass., by February 8. Further information and application blanks may be obtained from the office of the Graduate School or from the Director of the Harvard Forest, Petersham, Mass.

Air Seasoning California Redwood

Victor H. Clausen
Engineer, California Redwood Association, San Francisco.

ONE TREND IN the conservation of our forest resources which probably deserves more attention than it has received in the past is the continuing improvement in methods of producing more and better lumber from increasingly lower-grade logs. Technological advancement in the manufacture of lumber is a major factor in extending the present supply of old-growth timber and obtaining maximum utility from all that is harvested.

The degree of intensity to which any mill can utilize a given stand of timber is dependent largely upon the efficiency of the mill. The minimum quality of raw material for marginal operations must be higher than for more efficient mills. The term "efficient mill" as used here means efficiency not only in obtaining maximum quantity of material, but also maximum quality of product, and quality of product is becoming increasingly important, especially in the redwood industry which is experiencing a growing demand for material suitable for natural finishing. The mill manager, who a few years ago concentrated his attention on daily mill cut, today divides his attention between quantity and quality. He is as interested in percentages of upper-grade lumber as he is in maximum yield from logs and sawmill. By reducing sawmill waste and increasing the average value of the lumber produced, the mill manager can afford to process material which heretofore had been passed over in the logging operation as unmerchantable.

It is on the basis of improving quality and quantity of lumber products from the forest resources of the Redwood Region that much of the development work of the California Redwood Association is undertaken. Improved methods of log breakdown, statistical quality control of lumber thickness and moisture content, and drying redwood are some of the standing research projects conducted by the Technical Division of the California Redwood Association. These projects reflect the desire of the industry to reap the fullest utility from its harvested logs.

Within recent years, the redwood industry through its association, has contributed research funds to developing improved methods of seasoning redwood. The most perplexing problems of drying redwood occur in kiln drying and it was in this field that many of the problems were solved first. Secondary problems arising in the pre-air seasoning of redwood have also received attention. It is the purpose of this paper to report some of the findings.

The moisture content of redwood, as it comes from the sawmill, may range from a low of 40 per-

FIG. 1.—Redwood pre-air seasoning yard. Showing end view of the test drying yard; the piles are spaced six feet apart.

cent to over 250 percent. By segregating redwood into groups, depending upon the moisture content and other variables such as density and growth rate which affect the difficulty of drying the species, the process of seasoning is simplified. The most difficult lumber to dry is put into the "heavy" or "sinker" classification. Redwood of this class has a moisture content in excess of 150 percent. It usually accounts for about 70 percent of the total volume of lumber to be kiln dried. The remaining lumber may be divided again into "medium", which contains lumber in the moisture content range of 75 to 150 percent, and "light" which contains lumber having a moisture content of less than 75 percent. The medium and light lumber may be treated as one class.

Redwood lumber can be successfully kiln dried regardless of its moisture content. However, because of the costs involved, the usual procedure is to place the sinker-and medium-segregated lumber in the air-seasoning yard until the moisture content approaches an equilibrium with the relative humidity of the air and then to place it in kilns for final drying. Light lumber is often kiln dried directly from the sawmill.

The efficiency of any air-drying yard is dependent upon the interaction of several factors, including speed of drying and amount of lumber dried per acre per year. Speed, or rate of drying, controls that part of the cost of air-drying which results from interest and taxes on the lumber while in the drying yard. Lumber dried per acre per year is a measure of those costs of drying which accrue from investment in yard. The ideal yard would be one in which the sum of these two variables would be a minimum for seasoning the lumber to the desired moisture content. Since wider spacing between individual piles will give faster drying the yards should be opened until the increased costs, due to the additional yard area required, exceed the savings made possible by the smaller inventory of drying lumber. It is where these two cost increments are equal that the air-drying will be accomplished at the lowest possible cost.

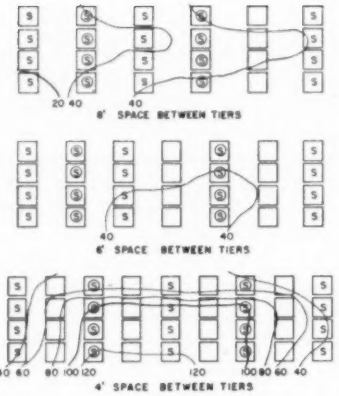


FIG. 2.—End view drawing of blocks of 1-inch sinker redwood showing lines of equal moisture content which would exist after 270 days of air-drying if all the lumber had an initial moisture content of 200 percent. Units in which samples were kept are indicated with an "S". Those in which the "S" is circled were sampled only in the blocks of sinker lumber.

Test

Several years ago preliminary tests were run on pile spacing to reduce the time for air-drying which, frequently, was as long as two years. Experimental areas were set up in the yards and the spacing between piles was increased from the usual 18 inches to 3 feet and more. The results of these tests were so satisfactory that the association decided to make a thorough study of the relation between yard pile spacing and cost of air-seasoning. Using the preliminary tests as a guide, a newly constructed three-acre yard at the Arcata Redwood Company on the Pacific Coast of Northern California was set up to test the effect of spacings of 4, 6 and 8 feet between piles on the cost of air seasoning.

The test was planned so that entire sections of the yard were on each of these three spacings. Each of the various segregations to be tested was included in each of the three spacings. Segregations included in the test were 1 and 1¼ inch sinker and 1 and 2 inch light, which in this study was a mixture of light and medium. By means of sample boards, the rate of loss of moisture in the lumber in individual packages was followed as the test progressed. Upon the completion of the test, the data were analyzed by converting the rate of loss in moisture content to "corrected drying rate factors" for each of the sample boards. The corrected drying rate factor is an empirical concept based on the observed fact that the ratio between the rate at which a board loses moisture and the residual moisture content of the board in excess of the equilibrium conditions of the drying atmosphere tends to remain constant as the lumber dries. The value of the corrected drying rate factor for the comparison is that it eliminates the effect of variation in moisture content between samples.

The tests showed that the wider the spaces between piles, the faster and more uniformly the lumber dried. Figure 2 shows the pattern of moisture contents which would result in blocks of 1-inch sinker on three different spacings if all the lumber had an initial moisture content of 200 percent and was allowed to remain in the yard under the drying conditions of the test for a period of 270 days. A great difference is apparent in the rate at which the lumber dried in various places in the block on the 4-foot spacing. However, in the blocks having 6-and 8-foot spacing, there is little difference in the moisture content between the packages in the fastest and slowest drying positions. Since the yards are planned so that each block is entirely removed at one time and placed in the kiln, the effect of the uniformity of drying can be appraised by assuming that the slowest drying package of each block will determine the length of time that each block will be kept in the drying yard. So that in spite of the quick drying which may occur in the outer packages, the time necessary to dry the block in the yard is dependent upon the slowest drying package.

Figure 3 shows the effect which pile spacing had on the rate at which the lumber dried in the slow-

est drying packages in the 1-inch sinker blocks. It is apparent from Figure 3, and similar curves for other segregations, that the lumber on the wider spacings dried faster than on the narrower spacings, but that after the pile spacing had been increased to 6 feet the rate of increase, with increase in spacing, slackened off.

Turnover of 1-inch sinker lumber per acre per year dried to any given moisture content was greater on 6 feet than on 4 feet but, unlike the rate of drying, further increases in pile spacing reduced the rate of volume turnover, and turnover at 8 feet was less than at 6 feet. Apparently this relationship results from the fact that as the yard is opened at the narrower spacings, the rate of drying increases rapidly so that even though it is not possible to get as much lumber on each acre of yard, the faster rate of drying results in a net increase in volume turnover. However, since the increase in drying rate tends to level off with increased spacings beyond a certain point, the effect of less lumber on each acre on spacings beyond that point more than offsets the decreased time required to dry the lumber on the wider spacings. The net effect of wider spacing beyond the critical point is to decrease the annual turnover rate per acre of yard.

Analysis of the effect of other segregations on rate of turnover indicated that maximum turnover per acre was dependent upon the segregation and thickness as well as on the pile spacing. The 1¼-inch sinker had a maximum turnover on the 6-foot spacing, while maximum turnover of 2-inch light occurred on a spacing of 8-feet. The interaction of the several variables, which are to be considered

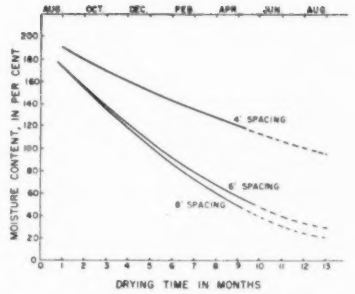


FIG. 3.—Moisture content to which 1-inch sinker redwood lumber will air dry as a function of the time it is in the drying yard in blocks having 4, 6, and 8 foot pile spacings.

in arriving at any conclusions, necessitated reducing the experimental data to a cost basis. The cost analysis showed that by far the largest part of the cost of air-seasoning redwood resulted from these costs, based on the value of the lumber in the yard. The costs based on the yard and its improvements represent less than one-tenth of the total cost of air-drying. Because of this, the effect of turnover per acre per year had much less of an effect on the total cost than did the rate of drying. A graphical presentation of the cost study for the air-drying of 1-inch sinker on the three spacings to various moisture contents, is shown

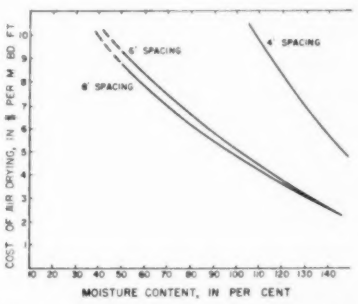


FIG. 4.—Cost of air-drying 1-inch sinker redwood lumber, on three different pile spacings, as a function of the moisture content to which the lumber is air dried.

in Figure 4. Detailed analysis of the relationships shown indicated that the actual minimum cost would be incurred if a spacing of 7 feet were used.

In order to determine the spacing in the yard which would result in the lowest costs when all segregations and thicknesses were considered, a study was made of the effect of 6-and 8-foot spacings on the cost of drying a typical mill production of the various segregations produced. The results indicated that .065 acres more per million board feet dried per year would be needed if 8-foot spacing were used rather than 6-foot spacing. This represents a difference in the initial capital investment of approximately $780 per million feet, dried per year. The analysis further indicated that spacing the piles 8-feet apart will result in a total drying cost of $745 less per million board feet dried than if a 6-foot spacing is used, and that even lower costs could be anticipated if a 7-foot spacing were used.

Conclusion

Because of these and similar tests, wide yard spacings, which only a few years ago were considered unreasonable, are now becoming the standard in the redwood industry. By opening the yards and placing less than half as much lumber on each acre of expensive yard, mill management has found that more than half the time, that was formerly used to air dry, can be saved and that costs can be reduced proportionately. Most of the 250 to 300 million feet of redwood air-dried annually is now dried in yards with 5-to 8-foot pile spacing effecting a savings over the former narrower spacings.

Refrigerated Storage of Conifer Seedlings in the Pacific Northwest

Forrest W. Deffenbacher and Ernest Wright

Respectively, nurseryman and pathologist, U. S. Forest Service, Portland, Oregon.

In the Pacific Northwest cold storage is necessary to provide dormant trees for many planting projects. Some projects need trees before lifting can start in the nursery; others, not until new growth has started in the nursery. Cold storage makes it possible to meet these needs with trees in good plantable condition, and has several advantages for nursery operations. Cold storage allows quantity production in lifting and packing and permits concentration under supervision of trained workers. Cold storage at the nursery also allows planters to order trees in small amounts, thereby eliminating heeling in and extra handling on the planting job.

One early storage test (1943) was made for Douglas-fir and Port-Orford-cedar.[1] Stock held for two months in a cold room was planted with freshly dug stock in the Coast Mountains. First and ninth year survival and growth was practically identical for both stored and freshly dug seedlings. The storage period was short but indicated the possibilities of cold storage in the handling of nursery stock.

To develop storage techniques for the Pacific Northwest region, several experiments have been carried on at the Wind River Nursery and vicinity, on the Gifford Pinchot National Forest. This article summarizes some results of these experiments and of experience gained in seeking answers to the following questions:

1. What is the optimum temperature and humidity for storage?
2. What are the best packaging methods and materials?
3. What is the maximum length of time trees can be stored?
4. What effect does cold storage have on moisture content of trees?
5. What effect does cold storage have upon mycorrhizal association and mold growth?

[1]Ruth, Robert H. Survival and growth of fresh and stored planting stock. U. S. Dept. of Agric., Pacific N. W. Forest and Range Expt. Sta. Research Note No. 93. November 1953.

Temperature and Humidity

Controlled temperature and humidity were found to be necessary to prevent mold development and maintain moisture in the stock. A temperature of 35°F. and storage-room humidity of 90 to 95 percent gave the best results. With a 35° temperature, if the humidity was allowed to drop below 90 percent, dehydration of the tops began. When the temperature rose above 35°, injurious mold developed. At temperatures below 33°, it was difficult to maintain a high relative humidity in the room, and dehydration of the tops begins and moisture is drawn out of the packing material causing the roots to dry.

Throughout all storage, free circulation of air was maintained to prevent dead air pockets. Bundles of trees were placed on racks with air space around each bundle. If the bundles touched or if the tops of trees in adjacent bundles touched, injurious mold developed. An air space was also maintained between the bundles and the walls and floor of the storage room. Electric fans circulated air to all parts of the room. An electric light was always kept burning in the storage room because of evidence that the light retards molds that grow in the dark.

Methods of Packaging

Packaging trials showed it is important to keep as much of the tree tops exposed as possible without allowing the roots to dry. The more top covered by the packing material, the greater was the development of injurious mold on the tops.

Three different methods of packaging were tried: (1) bulk, (2) crates, and (3) bundles. For the bulk method, seedlings were piled in layers between layers of packing material. This method resulted in too much drying of roots. Packaging the trees in crates with the roots in moist packing material, was unsatisfactory. The crates apparently inhibited air circulation around the tops and encouraged mold growth. There was some indication also that mold started on the wood of the crates and progressed to the trees, apparently because the wood was in direct contact with the wet packing material.

Packaging in tightly bound bundles was found to be the best method. Two kinds of bundle wrapping material were tried, "ocean wrap" and burlap lined with waxed paper. Ocean wrap, a commercial wrapping material with a cloth and plastic base, was found to be the better. It is waterproof and comes in rolls 36 inches wide and 100 yards long. The rolls were cut in halves, the resulting 18-inch width being ample for good bundles. It was noted that wet or green stiffening slats became covered with mold that progressed to the trees. This did not happen when dry cedar slats were used; the wrapping material prevented them from absorbing moisture from the bundles.

Period of Storage

Several tests were conducted to determine how long bundled trees may safely be held in cold storage. Species used in these tests included Douglas-fir (*Pseudotsuga menziesii* var *menziesii*), ponderosa pine (*Pinus ponderosa* Laws.), noble fir (*Abies procera* Rehd.), and Sitka spruce (*Picea sitchensis* [Bong.] Carr.). Trees were dug from nursery beds, bundled in the conventional manner, and the bundles placed in the cold storage room. In the first test, the bundles were opened at intervals of 4, 6, 8, 12, and 18 months, and a hundred trees were removed and planted in the nursery. Survival at the end of the first season was excellent for all species stored 8 months or less (Table 1).

Since six months was considered as long a storage period as would

generally be necessary, a survival test using 100 trees of each species after six months storage was replicated four times from 1949 through 1952. Survival was not affected by storage except for ponderosa pine packed in sphagnum moss (Table 2).

In April 1951 a parallel test was run on a representative planting site. Samples of stored stock and freshly dug stock of the same seed source were planted in the field. Percent survival in October was as follows:

Species	No storage	Stored 6 months
Douglas-fir	15	64
Noble fir	24	47

A severe killing frost on May 29, 1951 influenced survival of the check Douglas-fir trees because these freshly dug trees started growing sooner after planting than did the stored stock.

These experiments and observations on many planting projects indicated strongly that proper cold storage was not injurious. In order to further strengthen the evidence, another test was made on a burned, clearcut area in the spring of 1952. This test was carefully designed for statistical analysis. The objective was to compare the survival of trees stored six months in shingle tow and in sphagnum moss with survival of trees freshly dug from the nursery. Three species were tested: Douglas-fir, noble fir, and ponderosa pine. The treatments were: (a) no storage, (b) six months cold storage in washed shingle tow[2] and (c) six months cold storage in sphagnum moss. A randomized split-block design was used with 10 replications of plots. One row of 10 trees of each treatment and species was planted in each plot or a total of 90 trees per plot; 900 for the experiment. Position of rows in each plot was chosen at random.

The following precautions were taken to insure integrity:

1. The clearcut area chosen for the test had burned very hot the summer before planting. This tough site was selected to magnify any effects on survival.

[2]Byproduct from the manufacture of western redcedar (*Thuya plicata* Donn.) shingles.

TABLE 1.—FIRST-YEAR SURVIVAL AFTER VARIOUS PERIODS OF COLD STORAGE (Nursery planting 1949)

Species[1]	Survival percent after storage of—				
	4 mos.	6 mos.	8 mos.	12 mos.	18 mos.
Douglas-fir	100	98	97	39	0
Ponderosa pine	100	100	100	100	23
Noble fir	100	100	100	100	0
Sitka spruce	100	100	100	72	0

[1]100 trees of each species.

TABLE 2.—PERCENT SURVIVAL AFTER 6 MONTHS STORAGE (NURSERY PLANTING)

Species[1]	No storage				Packed in shingle tow				Packed in Sphagnum moss	
	1949	1950	1951	1952	1949	1950	1951	1952	1950	1952
Douglas-fir	100	98	100	86	98	99	98	100	98	100
Ponderosa pine	100	99	98	96	100	100	96	96	100	68
Noble fir	100	99	100	98	100	100	97	96	....	94
Sitka spruce	100	97	98	....	100	99	97	....	....	....

[1]100 trees of each species.

2. Plots were positioned in the clearcut area to sample a wide variation of site and exposure.

3. Obviously bad planting spots were avoided in locating the plots.

4. The plots (roughly 30 feet square) were chosen to be as uniform within boundaries as possible. Rows of trees in the plots were run up and down the slope.

5. The planting job was organized so that the trees of each treatment and species were handled alike during all operations from the nursery to the actual planting.

6. One planter planted all trees in a plot.

7. A 2-foot spacing between trees in the plots was used to minimize site differences. Each planted tree was marked with a cedar stake.

Just before stock was planted, the data shown in Table 3 were taken on root condition and amount of root-tip dieback. The mold-like fungus observed most frequently was *Rhizoctonia* spp. Apparently western redcedar shingle tow inhibited mold growth. A similarly desirable effect was also evident in the retardation of root growth on trees in storage.

A standard statistical analysis was made of the October survival (Table 4).[3] An analysis of variance indicated that:

[3]Grateful acknowledgment is hereby made to Floyd A. Johnson, Robert W. Steele, Kenneth Eversole, and Roy R. Silen of the Pacific Northwest Forest and Range Experiment Station for their assistance on statistical design and analyses.

1. With the exception of the sphagnum-packed ponderosa pine, there was no significant difference among the treatments.

2. When ponderosa pine was considered alone, the sphagnum, cold-storage treatment had a significantly lower survival percentage than the other two treatments. This can be attributed only to the sphagnum moss. It appeared that the moss had some effect on the dormancy of the ponderosa pine roots; some roots had new growing tips as long as ½ inch when the bundle was opened. When Douglas-fir was considered alone, the higher survival of the sphagnum-packed seedlings did not prove significant ($F = 2.94$ nonsignificant. $P.05 = 3.55$). The difference in survival, if any, caused by cold storage was so small that this carefully designed experiment failed to detect it.

Data from the 1952 nursery plots (Table 2) were not analyzed statistically because it was evident that the same trend existed in these data as in data for the clearcut area.

Moisture Content of Cold Storage Stock

During the course of this study the moisture content of the stock held in cold storage was determined separately for the roots and tops of the respective species. With the exception of Douglas-fir, the stock stored for periods up to six months retained a higher percentage of moisture in the roots than in the

TABLE 3.—CONDITION OF PLANTING STOCK, 1952

Species and packing material	Condition of mycorrhiza	Condition of roots	Amount of mold
Douglas-fir			
Shingle tow	Good	Occasional dieback ⅛"-¼"	None
Sphagnum	Better	Roots starting to grow	Superficial
Ponderosa pine			
Shingle tow	Well developed	Small amount of dieback mold on roots	None
Sphagnum	Less	Roots growing (½")	Considerable
Noble fir	Very limited	No dieback	None
Shingle tow			
Sphagnum	Absent	Started to grow No dieback	None

TABLE 4.—PERCENT FIELL SURVIVAL OF FRESHLY DUG AND STORED TREES, JULY AND OCTOBER 1952

	No storage		Packed in shingle tow		Packed in sphagnum moss	
Species	July	Oct.	July	Oct.	July	Oct.
Douglas-fir	92	73	94	74	96	84
Ponderosa pine	97	86	92	78	58	45
Noble fir	90	78	96	77	94	84

tops. From 6 to 12 months in cold storage there was progressively less moisture in the roots than in the tops. Noble fir and ponderosa pine seedlings had a somewhat higher percentage of moisture in the roots than either Sitka spruce or Douglas-fir. This may account, at least partially, for the better survival of ponderosa pine and noble fir after storage for one year. The moisture content remained at a high level until one year in storage; after a year it dropped to near 50 percent or less in the roots.

The seedlings packed in sphagnum moss regularly retained a higher percentage of moisture in both the roots and tops than those packed in shingle tow, for periods up to 8 months in cold storage. This advantage was sometimes more than offset by undesirable mold growth.

Effect on Mycorrhizal Associations

The roots of seedlings were examined to determine the effect of cold storage on the ectotrophic mycorrhizae present. Ponderosa pine and Douglas-fir, in these tests, had the best development of this type of mycorrhiza; on the roots of Sitka spruce and noble fir this type was much less abundant. Cold storage of the stock for periods up to six months did not appear to have a permanently damaging effect on the mycorrhizal associations. It was noted, however, that there was some slight shrivelling of the mycorrhizae as compared to their normal plump appearance on freshly dug stock. It appears likely that mycorrhizae quickly revive after planting, as judged by the good survival of the cold storage stock both in nursery and in field planting tests. The identity of the mycorrohizal fungi is yet undetermined.

Summary

There is a definite need for cold storage of conifer planting stock where nurseries serve planting areas at different elevations and climatic zones.

Survival tests in the nursery and the field indicate quite conclusively that if proper storage conditions are maintained, survival of trees is not impaired by storage up to six months. A high moisture content was maintained in planting stock throughout this period of storage; there was no apparent detrimental effect on mycorrhizal associations, and survival was not significantly different from survival of freshly dug trees.

Cold storage temperatures must be maintained at from 33° to 35° F., and humidity betwene 90 and 95 percent. Adequate circulation of air is needed. Trees should be packaged in waterproof bundles, their tops exposed, their roots packed in moist, washed shingle tow or moss.

Notes

Early Scrub-Oak Control Helps Longleaf Pine Seedlings

Release from overtopping hardwoods improves the growth of longleaf pine. This has long been observed. But the optimum age for release of grass-stage seedlings has been a subject for conjecture only. A recent study in south Alabama indicates that growth and survival suffer where scrub-oak competition is removed later than the end of the first growing season. Whether growth of seedlings can be further improved by their release at germination time, or by cite preparation a year before, is expected to be shown by supplemental study.

Area and Methods

The main study was initiated in the winter of 1948-49 in the Escambia Experimental Forest and the Conecuh National Forest. Longleaf pine (*Pinus palustris* Mill.) seedlings from the exceptionally heavy 1947 seed crop were observed in dense stands of scrub oaks under which the seedlings had germinated. The oaks were chiefly *Quercus incana* Bartr., *Q. laevis* Walt., Q. *marilandica* Muenchh., and Q. *stellata* var. *margaretta* (Ashe) Sarg.

Two general site-classes were sampled; relatively productive deep loamy sand or shallow sandy loams with heavy subsoil, and deep sands generally recognized as poor longleaf sites.

A randomized block design was used at three locations. Paired blocks were installed on a poor site on the Escambia, on a good site on the Escambia, and on a good site on the Conecuh. Each block was divided into square 1/10-acre plots to which the various treatments were randomly assigned. The treatments in the main study included release from scrub oaks when seedlings were from 1 to 4 years of age, and no release. Seedling data were taken on 100 quarter-milacre subplots located inside ½-chain isolation strips within the 1/10-acre treatment plots.

The scrub oaks were killed with Ammate. To reduce confounding influences, all pines except the 1947 longleaf seedlings were removed from the plots and when the seedlings were 3 years old they were thinned to a maximum of three per quarter-milacre subplot. All plots were prescriptively burned for brown-spot control when the seedlings were 2 and 4 years old.

When the seedlings were 4 years old, the root-collar diameter of the largest one on each subplot was recorded. At the same time, survival was estimated from the percentage of quarter-milacres that still had at least one living seedling.

Results

Diameter growth—The seedlings benefited from early removal of the scrub oaks (Fig. 1). Release one year after germination brought about faster root-collar diameter growth than did more delayed treatment. Four-year-old seedlings that had been released at one year of age averaged about 56 percent larger in diameter than those never released. Removal of competition when seedlings were two years old also appeared more effective than later release. These effects of oak control held true on good and poor sites and on both forests (Table 1).

Site quality made no appreciable difference in the growth of released seedlings. But unreleased seedlings on the Escambia showed 36 percent better growth on good sites than on poor sites. Thus it appears that early oak control is more effective on poor sites than on good ones.

In the supplemental study, release at germination time produced

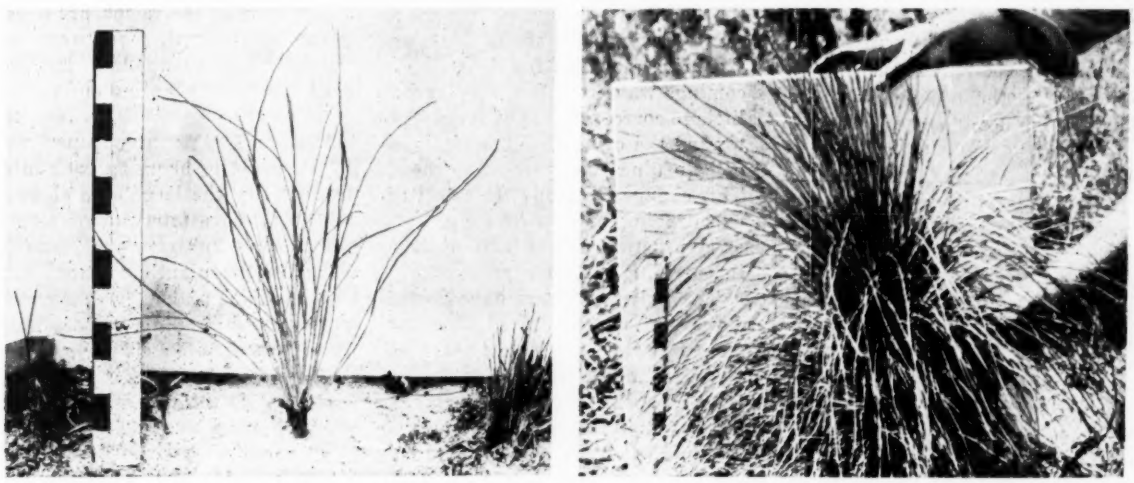


FIG. 1.—*Left*, four-year-old longleaf pine seedling never released from scrub-oak competition. *Right*, another 4-year-old seedling established under oaks but released at age 1. Note scale.

TABLE 1.—AVERAGE ROOT-COLLAR DIAMETERS OF RELEASED AND UNRELEASED SEEDLINGS AT FOUR YEARS[1]

Time of release	Escambia		Conecuh	All sites
	Poor site	Good site	Good site	
	Inch			
At age 1	0.48	0.46	0.62	0.53
At age 2	.39	.39	.58	.46
At age 3	.32	.32	.46	.37
Unreleased	.25	.34	.41	.34

[1]Treatment and location differences were significant at the 5-percent level (*F* test).

TABLE 2.—ROOT-COLLAR DIAMETERS OF SUPPLEMENTARY-STUDY SEEDLINGS AT ONE YEAR[1]

Time of release	Poor site	Good site	Both sites
		Inch	
One year before germination	0.15	0.16	0.15
At germination	.18	.24	.21
Unreleased	.11	.16	.14

[1]Treatment and site differences were significant at the 5-percent level (*F* test).

larger one-year-old seedlings than did either release one year prior to germination or no release (Table 2). Control of oaks ahead of seedfall permits herbs and grass to become so firmly established that they replace the hardwoods as competitors. In nearby openings where the principal competition is grass, the pine seedlings are no more vigorous than under oaks, where there is little grass.

Diameters of the supplemental-study yearlings—both released and unreleased—were greater on good than on poor sites. This difference between sites eventually may be evident only among unreleased seedlings, as it now is on the 4-year plots.

Survival.—Seedling survival in the main study was significantly better where the oaks were controlled early (Fig. 2). Among pines freed from hardwood competition after one year of growth, survival was 98 percent. Of the unreleased subplots, only 76 percent had living seedlings. When survival rates for each year's treatments were compared and tested by chi square, the differences proved highly significant. Site quality apparently was not a significant influence over the four years. Survival data from the supplementary study are not yet available.

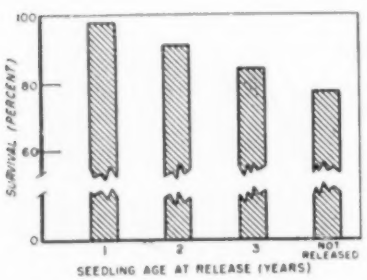


FIG. 2.—Effect of scrub-oak removal on fourth-year survival of longleaf pine seedlings.

Conclusion

Longleaf pine seedlings should be released from scrub-oak competition. In terms of survival and growth, the best time for release appears to be during the first year after the pines germinate.

LAURENCE C. WALKER
East Gulfcoast Research Center, Southern Forest Experiment Station, New Orleans

Private Forestry in Great Britain

The present position of private forestry in Great Britain is remarkable in that it presents two sharply contrasted aspects, one favorable and the other unfavorable. The former will require time to exert its full influence, the latter is adversely affecting owners right now. The future appears to be somewhat uncertain, and to depend on how long the owners can hang on in the face of the adverse conditions, and on how long it will take to overcome these conditions.

The favorable aspect is seen in the changed attitude of the Forestry Commission, from blaming the private owners for their shortcomings which the Commission did little to correct, to one of sympathy toward the owners' difficulties and of helpfulness in overcoming them. This change is having the effect of encouraging owners to adopt forestry practices and of helping them in carrying out these practices.

The private owners have joined forces to form the United Kingdom Forestry Committee, composed of representatives of the Royal Forestry Society of England and Wales, Royal Forestry Bounty of Scotland, Country Landowners Association and a number of other organizations interested directly or indirectly in forestry. This Committee meets at frequent intervals and gives careful and thorough consideration to all matters affecting private owners. Its work has been so effective that it has become the recognized link between the private owners and the Government, and its recommendations receive careful consideration. In 1952 it prepared a statement of policy which it put before the Forestry Commission. In 1953 a number of concessions were made by the Forestry Commission, all of them welcome, and all helpful.

Agricultural wages, which apply also to work in the woods, are fixed by the Government. They were increased in August, 1953. In October, the forest planting and maintenance grants were increased to $42.00 and $.70 per acre respectively. To assist in bringing back into productivity the large area classed as scrub, devastated or derelict, grants for scrub clearance, in addition to the planting grant, will be available under certain safeguards, and in different amounts up to a maximum of $35.00 per acre. Small woods which are not dedicated and therefore not eligible for grants because of possible changes in ownership will now be allowed grants at half rates, provided they are managed under an approved

plan. The thinning grant is available to all classes of owners. These grants show clearly the desire of the Government to help private owners make good the ravages of war.

The unfavorable aspect of private forestry in Great Britain is due to low prices and poor markets for the only classes of material that the depleted forests are capable of yielding at the present time, namely, mine timbers from plantations, and low grade hardwoods, with a few poles and small softwood saw logs. The price of mine timbers is controlled by the National Coal Board, which, since the coal mines have been nationalized, enjoys a complete monopoly and is free to buy from other countries at the lowest prices. Furthermore, the mines have been operated at such a loss that the Board has been forced to take the unpopular step of raising the price of coal, which has been still further increased by higher freight rates charged by the nationalized railways. The result has been that the price of mine timbers has fallen from $14.00 to $6.80 per ton in the face of rising costs. Other forest products are unable to compete with the better quality, yet cheaper, imported products. Obviously, under such conditions private owners could not be expected to incur the expense of planting and improving their forests, and private forestry would suffer a severe setback.

Add to these unfavorable factors the heavy losses of coniferous timber in Northeast Scotland caused by the severe gales of January, 1954, which blew down an estimated 48,000,000 cubic feet, and the difficulties of private forestry are easily understood. In this case, the Government was very helpful in the salvage operations through the National Coal Board, which accepted the mine timbers at a fixed price, and through the nationalized railways which bought all the sawn lumber and cooperated in transportation problems.

Faced with such unfavorable conditions, there was little that the owners could do by themselves, and, as the Government had shown, that, after two wars, it realizes the importance of growing timber at home, the owners turned to the Government. In November 1953, the United Kingdom Forestry Committee laid the position before the Minister of Agriculture and the Secretary of State for Scotland, with the request that a departmental committee be appointed to examine timber marketing in all its aspects, and to advise on measures to improve the marketing of products from privately owned forests. On April 30, 1954, the Minister of Agriculture announced in the House of Commons that such a committee had been appointed, and gave the names of its members which included the well known forester, Professor H. M. Steven of the University of Aberdeen. Although immediate improvement is not to be expected, the appointment of the advisory committee in the Department of Agriculture will be distinctly encouraging to the hard-pressed private owners.

BARRINGTON MOORE
Stone Acre,
Corfe, Tauton, England

Rot and Cankers on Oak and Honeylocust Caused by Poria spiculosa

In the course of a rot study in bottomland hardwood types of the Mississippi Delta, a number of oak and honeylocust trees were observed to have small, roughly circular cankers or swellings on their boles. The centers of these cankers were filled with sterile fungus material. Dissection of some trees revealed that extensive heart rot was associated with the cankers. This type of canker has been observed most frequently on young willow oak (*Quercus phellos* L.), but has been found on Nuttall oak (*Quercus nuttallii* Palmer), water oak (*Quercus nigra* L.), and honeylocust (*Gleditsia triacanthos* L.).

Although it is doubtful if more than 1 percent of the trees of the susceptible species have this type of defect, it is important that foresters be able to recognize the canker and associated rot when they are selecting growing stock trees or making improvement cuts.

Cause

Numerous cultures prepared from the material in the center of cankers and from the associated white heart rot behind the cankers yielded only one fungus. This was identified as *Poria spiculosa* Campbell and Davidson, the same fungus reported to cause similar cankers and rot on hickory and oak along the Atlantic coast.[1] The fruiting bodies or sporophores of this fungus are not found on standing trees. They are produced only on affected trunks of fallen trees that have been in contact with the ground for several years. No sporophores were found during the course of this study.

Cankers and Rot on Oaks

On the bottomland red oaks, *Poria spiculosa* cankers are roughly circular and vary in size from two to six inches. There are usually traces of an old branch stub in the center of the canker, and the branch wood has been replaced by brown sterile fungus material (Fig. 1, *A* and *B*). When young these cankers are rather inconspicuous, but the infected branch traces are much more swollen than uninfected ones. Doubtful infections can be identified by making an ax cut into the center of the suspected canker. If *Poria spiculosa* is present, the brown sterile fungus material will be revealed by the ax cut.

In order to study the extent of decay in relation to the cankers, eleven infected willow oak trees ranging from seven to eleven inches in d.b.h. were felled and dissected. The cankers were all on the lower trunk, the lowest being ½ foot above the ground and the highest 15 feet. All of the cankers had originated at branch stubs. These stubs were ½ to 1 inch in diameter. The age of each canker

[1]Campbell, W. A., and R. W. Davidson. A species of *Poria* causing rot and cankers of hickory and oak. Mycologia 34: 17-26. 1942.

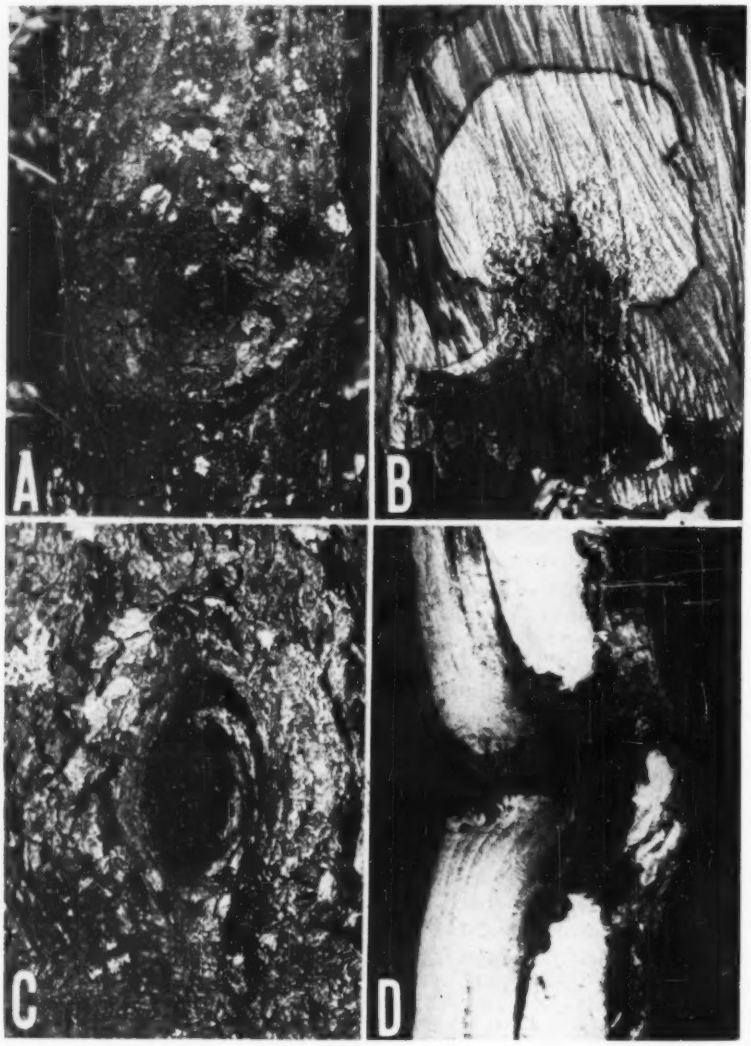


FIG. 1.—*Poria spiculosa* cankers on oaks and honeylocust. *A*—Infected willow oak branch trace. *B*—Cross-section through infected willow oak trunk showing decay and sterile mycelium replacing branch scar. *C*—Infected honeylocust branch trace. *D*—Longitudinal section through infected honeylocust branch trace, showing mycelium plug replacing branch wood.

was determined by ring counts taken on the callus that the tree had formed around the infected branch trace. Total length of the visible white heart rot behind the cankers was recorded to the nearest ½ foot.

Plotting these data indicated a relation between length of rot and age of cankers. In Figure 2, the points represent the data for the 11 cankers. The line through the origin was fitted by the method of least squares with squared residuals weighted inversely proportional to age. The calculated regression is $\hat{Y}=.797X$, where $\hat{Y}$ is predicted length of rot in feet and X is age of canker in years. Thus, the rot in this sample lengthened approximately .8 foot per year.

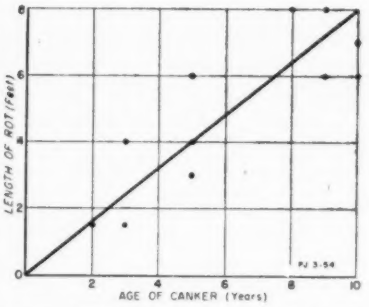


FIG. 2.—Relation between length of heart rot and age of *Poria spiculosa* cankers on willow oak. The rot increases in length about .8 foot each year.

For practical purposes a forester may consider that any tree with a *Poria spiculosa* canker on the first log is likely to be badly rotted and will probably be a total cull within ten years or less.

Cankers and Rot on Honeylocust

Poria spiculosa has not previously been reported to infect honeylocust, but in the present study it was collected from this host in Mississippi and Tennessee. All the cankers or swollen knots so far observed were relatively young, but could be identified by the somewhat greater than normal swelling around the branch traces (Fig. 1, *B* and *C*). Cutting through the center of the canker revealed the brown core of sterile fungus material which is characteristic of *Poria spiculosa*. Dissection of a few trees showed that white heart rot was associated with these cankers.

E. RICHARD TOOLE
Southern Forest Experiment Station, U. S. Forest Service, in cooperation with Mississippi Agricultural Experiment Station, Stoneville, Miss.

Fire Line Construction With Forced Air

Fire fighting in the Missouri Ozarks has become increasingly mechanized in the past 10 years. The use of tractors and plows, side-delivery rakes, and pumper units have partially replaced the time-honored broom rake. During the 1953 spring fire season another type of mechanized equipment was tested on the University of Missouri Experimental Forest and the Poplar Bluff District of the Clark National Forest. The authors, assisted by John Harty of the University Forest and Owen Lashley and Ross Marion of the Poplar Bluff District of the Clark National Forest, adapted a blower for use on a small crawler tractor in an attempt to build fire line by moving the litter with forced air. Although not perfected at the present time, the results from the use of the blower are sufficiently encouraging to warrant reporting, since it offers the possibility of reducing suppression costs and gives a small fire crew a strong hitting force.

The blower, taken from a discarded silage cutter, is mounted on a Model 40 John Deere crawler tractor. The blower is 26 inches in overall diameter, 7 inches in width, and has a nozzle 6 inches in diameter (Fig. 1). The four fan blades are of heavy iron construction, since the blower was built to perform a beating and throwing action rather than to move air; considerable clearance between the blade edges and the blower case also reduces the air-moving ability.

The blower is powered by a flat-belt drive from the power take-off pulley. Although a blower speed of over 3,000 r.p.m. is possible, the maximum which can be maintained without slippage of the flat belt is 2,300 r.p.m.

Several types of nozzles were tested. With the nozzle approximately 6 inches from the ground, a clean but rather narrow line is made. Because the blower has a great overhang behind the tractor, the nozzle has to be raised approximately 18 inches from the ground to prevent damage in going over steep terrain. A Y-nozzle makes a wide line but fails to clean the center portion. The best results are obtained from a flared nozzle which is angled slightly forward so the air stream can be continually directed beneath the leaves as the litter is rolled forward and to the sides.

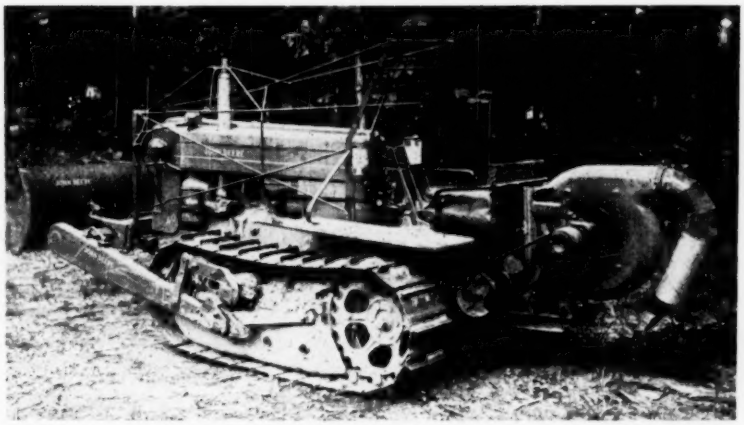


FIG. 1.—Model 40 John Deere crawler tractor with dozer and blower.

The tractor is equipped with a 6-foot dozer blade which is used in conjunction with the blower in building fire line. The blade moves the large obstacles such as logs, tree tops, and saplings. It also disturbs the litter enough to allow the force of the air from the blower to move it easily and produce a relatively clean line. When the blade is not used, the amount of follow-up raking of leaves is greatly increased. However, when the unit is working well ahead of the follow-up crew, the operator can make good line even through heavy litter by slowing and occasionally stopping the forward movement of the tractor with the steering levers; this allows the air stream to dig through to the ground. In areas which have been burned within the past few years, on rocky ground, and on trails and logging roads, the blower alone makes a completed line 3 to 6 feet wide (Fig. 2) which requires a minimum of follow-up raking. On nearly all fires, one man is able to clear the spots of leaves on the fire line missed by the blower. No difficulty is encountered in leaves drifting back into the line, but the best line is built when the blower is operated with a cross wind.

The ground speed in first gear with the blower operating at 2,300 r.p.m. is 0.8 m.p.h. This speed allows time for the blower to move the litter and is still as fast as a follow-up crew of 5 men can backfire and hold the line in windy weather. It is unnecessary to have a man in front of the unit to pick a trail either by daylight or at night.

The blower places very little load on the tractor motor after it reaches operating speed. However, the heavy blower fan acts as a fly wheel and makes deceleration slow. This has proven to be a hindrance when it is necessary to reverse the tractor; the gears cannot be shifted until the power take-off stops. The addition of a clutch to the blower pulley or an idler pulley to engage the belt drive would eliminate this difficulty.

The blower was used on 8 fires with line production varying from 30 to 60 chains per hour. The average rate of line production was 50 chains per hour, not including one summer fire. This fire was in steep terrain and there were several delays to adjust the belt drive. Both the blower and the tractor and plow unit were used on this fire, each making 60 chains of line in 2 hours.

The blower has certain definite advantages over a plow. It can be used over very rocky ground where a plow cannot make satisfactory

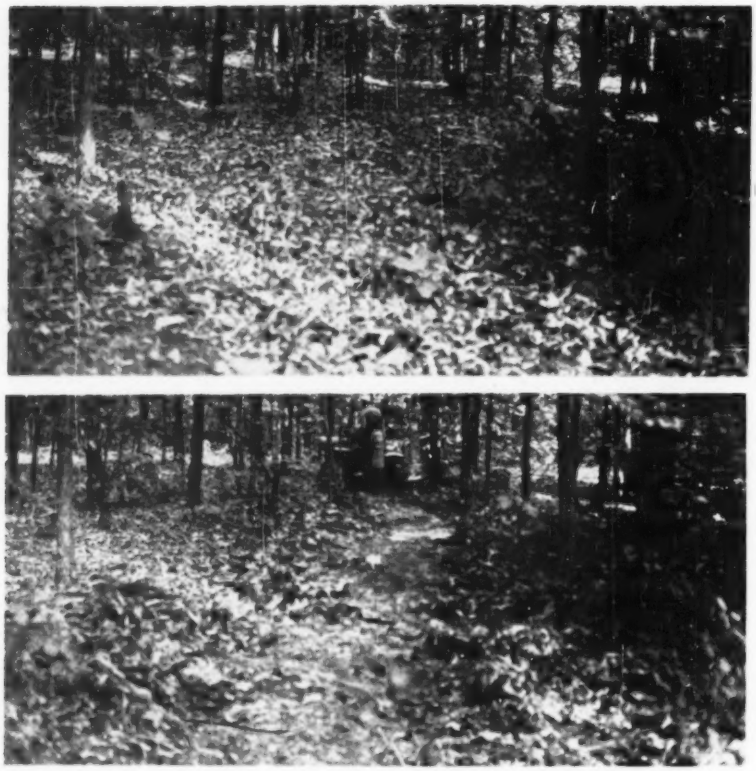


FIG. 2.—*Upper:* Heavy hardwood litter typical of large areas of the Missouri Ozarks. *Lower:* Fire line 3 to 5 feet wide built with the blower without use of the dozer blade at a speed of 0.8 m.p.h.

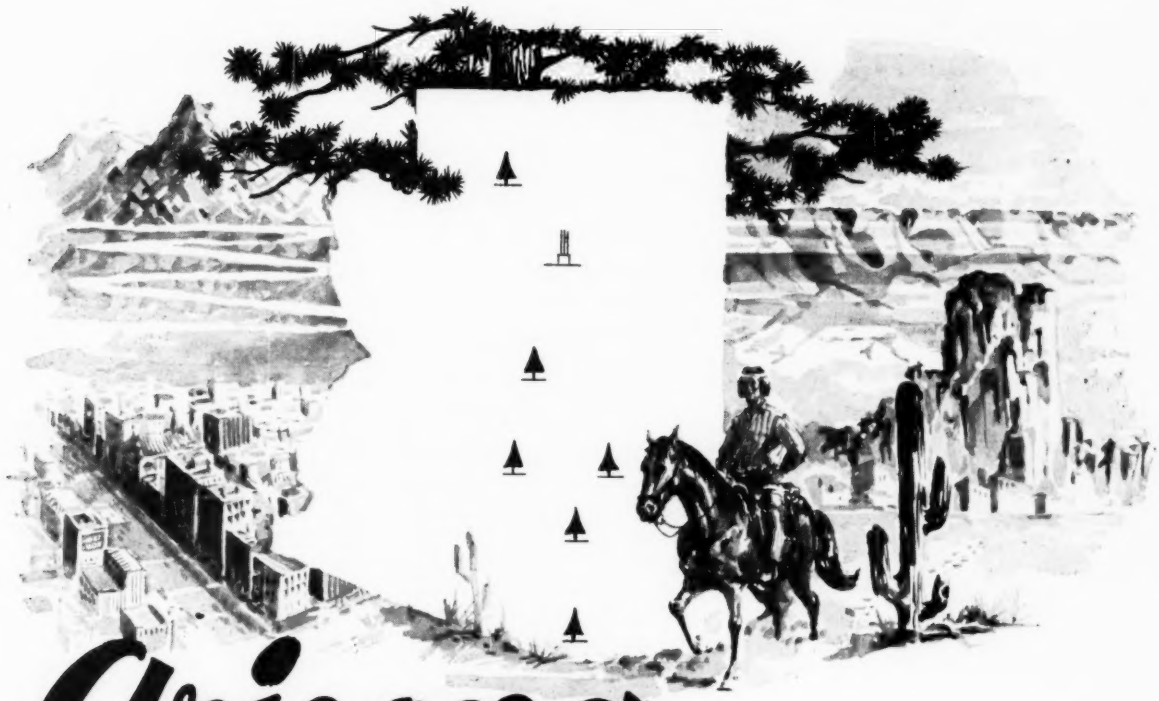
line, and is equally effective whether going up or down hill since the tractor has little more than its own weight to pull. Like the Ferguson fire rake, it leaves no furrows to start erosion. It is also very effective in clearing leaves from trails and roads. The blower is a simple unit and relatively trouble-free in operation; there is only slight chance that it would be damaged in use. It has the added advantage of being relatively inexpensive as it can be readily adapted to almost any tractor with a belt pulley.

The blower is not without disadvantages. It is not effective in grass, but this disadvantage can be overcome by the use of a dozer blade with the depth shoe. The unit is difficult to operate if the soil is excessively dry because the blower stirs up a great amount of dust. However, dry ground conditions are not common during spring and fall fire seasons in Missouri. The unit, as presently used, is somewhat unwieldy in a dense stand because of the width of the dozer blade and the considerable distance from the tractor pivot center to the rear of the blower.

The first attempt at fighting fire with forced air was surprisingly successful. However, several changes in the present unit are contemplated. The addition of a V-belt drive and a clutch on the blower pulley would permit a different pulley ration which would increase the blower speed in relation to the forward speed of the tractor. A blower which is smaller in diameter and greater in width might deliver more air than the present unit and also permit a more compact mounting which would make the tractor and blower unit more maneuverable. It seems possible that this type of fire-fighting tool can be made effective under almost all litter conditions in the Missouri Ozarks, even without the use of a dozer or V-blade on the front of the tractor. The possibility of mounting a blower on a small inexpensive wheel tractor or on a jeep, equipped with auxiliary power for the blower, should be investigated. Additional experimentation with different types and sizes of nozzles is needed.

J. M. NICHOLS and
PAUL M. KIHLMIRE
Asst. Prof. University of Missouri and Fire Control Staffman, Shawnee National Forest, respectively.

No. 2 of a series featuring state forestry practices, projects and products . . .



Arizona

—beginning of the Western Pine Region

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It is in the Kaibab that the great deer herds abound . . . and here is found the Kaibab squirrel. More than 12,000 cattle and 13,000 sheep forage each year within its confines.

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Reviews

Public Policy Toward Private Forest Land in Sweden, Norway, and Finland

By R. E. Marsh. 80 pp. Charles Lathrop Pack Forestry Foundation, Washington 6, D. C. 1954. $1.

This excellent publication describes basic features of public policy for private forest land, and the legislative and administrative means of implementation, in these three Scandinavian countries. It is based on several month's intensive study and field observations by one of America's ablest students of forest policy. Over the years, frequent reference has been made to the policy of Sweden and her neighbors, sometimes as argument for, sometimes against, some proposal in America. This reviewer finds this document most effective in clarifying the policy and practice of these countries. It will be a valuable aid to governments seeking to formulate or revise their forest policies. It will be an important source of information for any who wish to understand forest policy in these countries.

The author correctly states that an understanding of a country's forest policy requires some knowledge of the economic, political, and social conditions which influence its form and method of application. One chapter is devoted to each country, commencing with a brief but interesting description of such conditions. Then follows a description of basic policy features; the organization system and how it functions — illustrated with two charts; an analysis of the key law for the country; and the author's summary comments. An appendix includes English translations of the key laws and some important related laws and statutory regulations never before fully available.

These countries have much in common, though there are significant differences, especially in organization and methods. In contrast to the United States they are small, very homogeneous countries. Forests are vitally important.

Among the many facts that impress this reviewer: At the root of policy is the belief of these countries that continuing and enhancing forest yield is so essential to national welfare that private owners cannot be allowed full freedom of management. Regulation is required by national laws. These, together with closely integrated programs of forest extension and elementary training, service and advice to farmer owners, supply of

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seeds and planting stock, grants-in-aid, etc. are administered through local forestry boards. Members of the boards (in part appointed by the central government in Sweden and Norway), and their staffs, have the status of national government employees. General supervision over the boards is exercised by national boards (bureaus), but in Finland this is largely delegated to the two central forestry associations. National responsibilities in forestry in all three countries are under the Ministries of Agriculture. General forest education and extension, and cooperative associations of farmer forest owners, are well developed and very important. In Sweden, these associations operate many small mills.

The forest is a vital part of the farm. Farm forests comprise 50 percent of Sweden's forests, more in Norway and Finland. It is not surprising that there, just as in America, they are the most difficult ownership category upon which to be certain of good management.

This is a factual, objective, well-written document. It focuses on forest policy and its application, with only the attention to silviculture and other phases of forestry needed for background. One may hope that the author will also publish his observations on silviculture practices. The greatest contribution is the analysis of key laws and methods of administering them on the ground. Important, too, is the setting of conditions under which the policies of these countries evolved. I have not seen so clear a description of the impact of World War II upon forestry in Finland as given here.

This should prove a valuable source of information as to how these countries are attaining effective forest conservation. This reviewer feels some satisfaction for having stimulated this inquiry. The Charles Lathrop Pack Forestry Foundation is to be commended for making these findings available.

LYLE F. WATTS

The Effect of Synthetic Resin Adhesives on the Strength and Physical Properties of Wood Veneer Laminates

By Stephen B. Preston. 89 pp. Illus. Yale University School of Forestry, New Haven, Conn. 1954. $1.50.

In a study designed to determine the extent to which the properties of wood veneer laminates are influenced by synthetic resin glue lines, the tensile and flexural strength and certain elastic properties were investigated for hot-pressed plywood and laminated wood constructed of yellow poplar veneer. Six commercially important types of synthetic resin adhesive were used.

The study shows that the tensile and flexural strength and elasticity of plywood can be predicted more accurately from these properties of laminated wood of the same thickness of veneer bonded with the same adhesive than from the properties of solid wood. It is also shown that experimentally determined effective modulus of rigidity values for both types of contruction can be satisfactorily used to predict the additional deflection of beams which results from horizontal shear.

The study indicates also that synthetic resin adhesives differ basically from impregnating resins in their influence on the wood component. Of the properties investigated fiber stress at proportional limit in static bending was least influenced whereas modulus of rupture and work to maximum load in static bending the ultimate tensile

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strength were improved to the greatest extent. Properties, however, were not similarly influenced by all adhesives nor were all influenced proportionately by any one adhesive.

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Biological Conservation with Particular Emphasis on Wildlife

By John D. Black, 328 pages. Illus. The Blakiston Company, New York. 1954. $5.00.

The emphasis in this book is on wildlife conservation. The author's stated purpose is to produce a college-level textbook in general and biological conservation. Actually, it is a nontechnical introduction to wildlife conservation with some emphasis on the dependence of wildlife on man's use of soil, water, grasslands, and forests.

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For use in schools such as Dr. Black's Missouri State Teachers College, the wildlife approach in teaching conservation may have real value. Nontechnical students may more easily understand the principles of conservation if the emphasis is on living, warm blooded animals rather than on trees, soils, or water. Emotional empathy for the buffalo and its plight is undoubtedly easier to achieve than is concern for the plight of the American chestnut. It is to be fervently hoped, however, that the student will be able to bridge the gap from the emotional concern toward wildlife to the conservation of wildlife and all other organic resources, and the soils and water on which they depend.

Two approaches are used in this presentation. After introductory chapters on need and history of conservation, eight chapters deal with fundamental ecological considerations and summaries of water, grassland, and forest as wildlife habitats. The next 14 chapters contain a survey of the principle animal species of North America, including brief summaries of their importance, their habits, and habitats. There are three chapters on fish, one on reptiles and amphibians, one on invertebrates, five on birds, and four on mammals.

Much can be said on the question of whether an elementary book, such as this, should attempt the species approach. Should the student have a sketchy introduction to the economics, ecology and conservation of a considerable variety of species before he is given a thorough groundwork of principles which apply to all species? This reviewer is admittedly biased in favor of starting with a thorough study of the principles of ecology and management in which some information on species is used as illustrative matter.

The final chapter contains a brief annotated list of the federal and state agencies charged with the administration of natural resources.

WILLIAM L. WEBB
State University of New York

The Giant Cactus Forest and its World

By Paul Griswold Howes. 217 pp. Illus. Duell, Sloan and Pearce; and Little, Brown and Co., New York City and Boston. 1954. $7.50.

Of all the strange and weird desert plants of the southwestern United States, the giant or saguaro cactus probably most nearly symbolizes the region. The tourist sees the startling, gaunt, and stark outlines of the saguaro and believes that here must center much of the interest of this vast and different land. He feels a challenge to understand the nature of these plants, and how they can live in this harsh and waterless environment. Thus the author has been wise in his selection of the saguaro as the main character in his book, as it is the most spectacular and stimulating of all the varied and colorful biology of the entire southwestern desert region of North America.

The field covered has been sharply limited—the giant cactus and its world are described only in the geographical region where they occur southeast of Phoenix and during the period of four or five months of the year between January and May. Within these limits, it is a complete and thorough study of the ecology of this unusual life community. Most readers will find the volume sufficiently detailed and philosophical to start on imaginative flights of their own in considering the closely knit and incredibly complex life pattern within this desert island.

Written for the layman with many excellent illustrations, this book will also please some of the scientists, for whenever possible both common and scientific names are used. The inventory of natural history is fairly complete, and for the visitor to the saguaro desert area, or even to the resident who has long wondered about the bursting complexity of life in this dry and almost rainless land, this book will provide many accurate answers to questions while stimulating further questing.

Probably the one factor which will be of the most interest to everyone is simply the realization that here in a land of hot summer sun, very low rainfall, no living streams, sparse and often bitter vegetation, there still exists a full and aggressive population of plants, insects, reptiles, and animals and birds—each in a small niche in its relationship to the other living things, yet each a part of the living and pulsing pattern.

It is a start for a new approach in natural history literature so that each plant or each animal is considered as a part of the life complex in which it exists. It is not reading for an hour of light entertainment, but it is a book to go back to and to recheck and to study carefully and fully. It is well written and beautifully printed. The author is curator of the Bruce Museum of Natural History, History and Art, Bruce Park, Greenwich, Conn.

LON GARRISON
National Park Service

Agricultural Policy

By Rainer Schickele. 453 pp. McGraw-Hill Book Co. New York, N. Y. 1954. $6.50.

Schickele's book will be of interest to foresters because it highlights many of the differences between forestry and agriculture. It is not a mere review of interesting historical decisions in agriculture, but it tests out policies in terms of their actual accomplishment in relation to intended goals.

Agricultural policy is probably the single "hottest" domestic political issue of our time and we have Professor Schickele to thank for clarifying the position of those who oppose Mr. Benson's program, though he himself does not take sides. He demonstrates with both data and logic that the ill-fated Brannan Plan has much merit as

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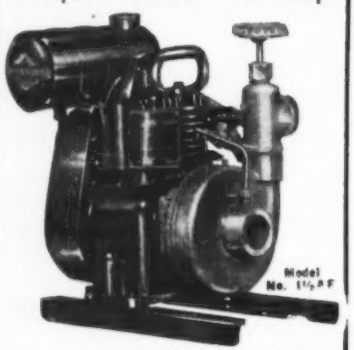

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the current planners in Washington have found in using it for wool and sugar.

Schickele tells us that realistic farm programs can assure that the American dream of freeholders on the land will continue to be realized. And he shows why family-type farmers resist being driven off their lands in the name of economic efficiency by resorting to action at the polls. That we live in a political economy and not an economy is well demonstrated by his review of the history of farm policy.

Basic to the farmers' troubles is the inadequacy of market and price bargaining power in their relationships with the large processor-buyers with resultant income disparity. The author demonstrates statistically the existence of this fact to those who might question it. That farmers resort to cooperatives and governmental programs to redress their imbalance is in keeping with the democratic process though some feel that immutable economic laws are flouted in the process.

Because price policies and their relationship to farm income are the most important feature of this text (as is the case with most books in this field) land and conservation measures are given only minor attention. This emphasis is of course completely strange to foresters who do not even have a current price reporting program for rough forest products. While we have several excellent texts on forest land policy the book has yet to be written which probes income relationships between growers and processors of forest raw materials. Rainer Schickele's book will serve as an excellent guide to some future forester-author.

CHARLES H. STODDARD

Thinning Problems and Practices in Denmark

Compiled by S. O. Heiberg. 92 pp. Illus. College of Forestry, State University of New York, Syracuse 10, N. Y. 1954. 80 cents.

World Forestry Series bulletin 1 merits careful study by all foresters concerned with silvicultural management. It is not the hope of the compiler that the information and practices contained in the bulletin should be adopted by foresters in this country, but that some of the practices may be adapted to conditions as they exist here.

Heiberg's introduction lays the foundation for a thorough understanding of the discussion of thinning by Danish foresters. The translation is well done. Metric units have been converted to English units which adds much to the value of the bulletin.

It is interesting to learn that long years of experience in Denmark have proven that within certain wide limits the density of the stand has little or no influence on the volume increment. Evidently no hard and fast rules govern Danish thinning practices. Danish foresters use high thinning, low thinning, and selection thinning as the particular portion of the forest indicates. One gathers that the application of Danish thinning practices is based not on rules, but on an understanding of the needs of the forest not gained entirely from books, but from living in and with the forest and an appreciation of the fact the forest is an infinitely variable community.

Two schools of thought are apparent among Danish foresters, the "active" thinning and the "wait and see." Proponents of the "active" thinning begin cutting at an early age and at once tentatively select final crop trees. In marking, the forester using this system asks, "Can the tree be cut without detriment to the stand?" The "wait and see" school delays starting until the pruning period is well along and trees have begun to show their true character. Tentative selection of final crop trees is made at that time. Foresters using this method ask, "Can the tree remain without detriment to the stand?" In general the two schools of thought are in agreement except on the time when thinnings should begin.

Within the past twenty years a new method, largely selection thin-

ning with the emphasis on the removal of the largest trees has appeared in Danish thinning practice. Juncker's method, so named for the forester who first used and developed it, is influenced often by economic considerations since larger and more saleable products are secured in the earlier thinnings, an obvious advantage to a private owner. It is a method which requires considerable technical knowledge and experience lest it result in simple "high-grading."

Most of the practices deal with Denmark's two most important species, beech and Norway spruce, both very tolerant. Whether the practices would be useable with tolerant species growing on poorer sites is an open question.

No attempt has been made in this review to compare the yields given in this bulletin with those secured in comparable stands here. Suffice to say, the yields are large and would seem to indicate that intensive forestry might be profitable almost anywhere. The great emphasis placed on the production of high quality products, especially in the case of beech, is noteworthy.

The bulletin is attractive and well printed on good paper. A high standard has been set for subsequent world forestry bulletins.

T. SCHANTZ-HANSEN

Publications of Interest

The *Biology and Control of the Englemann Spruce Beetle in Colorado* is a new Forest Service bulletin (U. S. Dept. Agric. Circular No. 944. $0.20) written by C. L. Massey and N. D. Wygant. It is an exhaustive study on this important subject.

• • •

The *1954 Directory of Organizations and Officials Concerned with the Protection of Wildlife and Other Natural Resources* is available at 25c per copy from the National Wildlife Federation, 232 Carroll St. NW, Takoma Park, Washington 12, D. C.

Yale Conservation Studies, Volume 3, includes articles on forestry in Japan, water pollution problems, national parks, and other subjects by students and graduates of the Yale Conservation Program. Priced at $1 from Yale Conservation Program, 77 Prospect St., New Haven, Conn.

• • •

Films available for loan from the U. S. Forest Service, Washington or regional offices include: *Little Smokey*, 12 minute sound film, released 1953, 16-mm Kodachrome, black and white, cleared for television. A documentary of Smokey, the forest fire preventin' bear, narrated by Hopalong Cassidy. *Longer Life for Wood* (The Role of Preservatives in Protecting Wood), designed to show the average user of wood the economic advantages of using treated wood in places where decay is likely to occur. It is a 17 minute sound film, 16-mm Kodachrome, black and white, released in 1954 and cleared for television.

For purchase information, write to the U. S. Dept. of Agriculture, Motion Picture Service, Washington 25, D. C.

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Current Literature

Compiled by MARTHA MEELIG, *Librarian, State University of New York College of Forestry*
Range Management Section Compiled by FRANCES FLICK, *Library, U. S. Department of Agriculture*

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Washington 6, D. C.

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College of Forestry
Syracuse 10, N. Y.

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RUTHFORD H. WESTVELD
Department of Forestry
University of Missouri
Columbia, Mo.

SCHOOL BOX SCORE
MEMBERSHIP, 1955 FISCAL YEAR

School	Student applications received: Dec. 1954	Total 1954 fiscal year	Total 1955 fiscal year
Alabama Polytechnic Institute	18	7	18
University of California	0	21	0
Colorado A & M College	0	18	0
Duke University	1	12	1
University of Florida	0	16	0
University of Georgia	10	38	10
University of Idaho	0	29	0
Iowa State College	3	32	3
Louisiana Polytechnic Institute	0	0	0
Louisiana State University	0	14	0
University of Maine	4	16	4
University of Massachusetts	4	16	4
Michigan State College	26	25	26
University of Michigan	6	22	6
University of Minnesota	2	21	2
University of Missouri	7	20	7
Montana State University	0	19	0
State University of New York	5	23	5
North Carolina State College	20	19	20
Oregon State College	3	17	3
Pennsylvania State University	6	33	6
Purdue University	24	19	24
Utah State Agricultural College	1	8	1
University of Washington	10	28	10
West Virginia University	3	21	3
Yale University	1	3	1
Totals	154	497	154

SECTION BOX SCORE
MEMBERSHIP, 1955 FISCAL YEAR

Section	Applications received[1]: Dec. 1954	Total 1954 fiscal year	Total 1955 fiscal year
Allegheny	9	68	9
Appalachian	24	48	24
Central Rocky Mountain	0	26	0
Central States	57	80	57
Columbia River	5	56	5
Gulf States	7	57	7
Inland Empire	1	39	1
Intermountain	1	14	1
Kentucky-Tennessee	0	5	0
New England	10	54	10
New York	7	40	7
Northern California	1	34	1
Northern Rocky Mountain	0	35	0
Ozark	7	49	7
Puget Sound	12	61	12
Southeastern	31	128	31
Southern California	0	2	0
Southwestern	0	7	0
Upper-Mississippi Valley	5	64	5
Washington	1	7	1
Wisconsin-Michigan	2	11	2
Totals	180	885	180

[1]Student, Junior, Affiliate, Associate (Initial) grades only.

Coming Events

National Watershed Congress

Statler Hotel, Washington, D. C., December 6-7.

Western Forestry and Conservation Association

The 45th Western Forestry Conference and the annual meeting of the Western Forestry and Conservation Association will be held at the Fairmont Hotel in San Francisco, December 7-10.

Fourth World Forestry Congress

Sponsored by United Nations Food and Agriculture Organization. New Delhi, India, December 4-17.

20th North American Wildlife Conference

The North American Wildlife Conference will hold its 20th meeting March 14-16 in Montreal, Canada. Theme of the meeting will be "Natural Resources Use—A Continental Challenge."

The President's Column

The Society's 1954 annual meeting in Milwaukee is now history. It will be remembered by the 700 members who registered and the 100 ladies who accompanied them as one of the most successful conferences of recent years. Thanks to the efficient and industrious local committees, everything went off on schedule and without a hitch. Even the weatherman cooperated, with mild Indian summer for the first two days and a few light showers thereafter, followed again by sunshine.

A full account of Council actions and of the Society Affairs session will appear in the January issue of the JOURNAL. The papers presented at the general session and in the Division meetings will be published in a separate *Proceedings* issue, as a supplement to the JOURNAL and in the same format so that it can be bound with other issues if so desired. Those who registered at the meeting will receive a copy of the *Proceedings;* others may obtain them at $4 per copy. Printing the *Proceedings* separately will subsequently lighten the backlog of JOURNAL material and speed up publishing. It will also give those who could not get to the Milwaukee meeting an opportunity at an early date to obtain a complete copy of all the papers presented.

The Council held an all day session on October 24 and cleared up numerous items of business. A report of Society finances indicated that we will end our 1954 fiscal year with a balance of nearly $5,000 above expenditures. Membership now exceeds 10,000, even though our campaign failed to bring in the 1,000 net increase in membership we had aimed for. These and other Society matters were discussed by Council members and Section delegates at the evening session on October 24. The Sections were well represented at this meeting and delegates as well as

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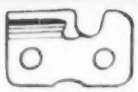

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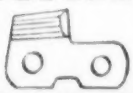

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Council members obtained many new ideas for strengthening the Society, particularly at the grass roots level. These joint conferences are now a feature of Society annual meetings and I urge their continuance.

The general sessions as well as the Division meetings were so well attended that additional space had to be made available for some sessions. Although many conversations and discussions were held in hallways and odd corners of the headquarters hotel, and many extracurricular activities took place outside, the main business of the regular program was not overlooked.

On the evening of October 26, Society members and their ladies were the guests of several world-famous Milwaukee breweries, and a number of forestry school alumni reunions were held concurrently. As was to be expected, a good time was had by all, and even staid old members joined in the singing and other festivities. Good fellowship is an important part of the annual meeting.

The high point of the meeting came on the final evening when 500 members and their ladies sat down to dinner following a reception and social hour as guests of the forest land-owning paper companies of Wisconsin. It became my honor and pleasure to present the Gifford Pinchot Medal to William L. Hall, one of the Society founders in 1900; and the Sir William Schlich Memorial Medal to Tom Gill. The feature address "A Broad Look at our Resource Problem" was delivered by Dr. Reuben G. Gustavson, president and executive director, Resources for the Future, Inc., Washington, D. C., and brought to a successful conclusion another annual meeting, which will be long remembered by all fortunate enough to be able to attend.

E. L. Demmon

Retired Status

Members and Fellows who retire from active forestry practice after having been members of the Society for 20 years or more may, upon application to the Council, continue as voting members, but have their dues remitted except for an annual charge of $5 should they desire to receive the JOURNAL OF FORESTRY and other Society publications. Members granted retired status in the Society must continue to pay Section dues in order to continue as Section members.

Retirement from "active forestry practice," as provided in Article V, Section 4, of the Society's constitution, shall be interpreted as applying to members retired from full-time employment, either in forestry or other fields, with consequent substantial reduction in the income of the members concerned.

Inactive Status

Society members temporarily serving in the armed forces may request that they be placed on inactive status. Other Society members may request inactive status because of financial stringency or for personal reasons, provided such requests have the approval of a Section.

Inactive members do not receive copies of the JOURNAL OF FORESTRY, nor are they permitted to vote. They are listed as members of the Society and may be restored to active status upon request, with the payment of current dues.

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Example of Chapter Activity

The Winyah Forestry Club, a chapter of the Society of American Foresters, presented an unusual event in September at the Annual Timber Festival, sponsored by the Georgetown Chamber of Commerce in Georgetown, S. C.

Competitions were held for woods workers in the Georgetown area. They consisted of log chopping and sawing contests with the pulpwood wheel saw, one-man chain saw, and two-man cross cut saw. First, second and third place awards were made of $25, $15 and $10 in each event. In addition to these, of all the events, a pulpwood bolt throwing contest drew the greatest interest. The bolt used was 5 feet 3 inches long and weighed 32 pounds. There were 18 men entered in this event and a record distance of 27.53 feet was made.

J. T. MAYNARD
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JOURNAL OF FORESTRY

Gentlemen:

I think the September, 1954, issue on forest genetics is an excellent example of how the JOURNAL OF FORESTRY has served as a helpmate to forestry progress down through the years. About 15 years ago, when I was a brash Junior forester fresh out of school, the JOURNAL published an article of mine entitled *Genetics in Forestry*. At that time I was disappointed and (I fear) irritated by the relative lack of interest in the possibility of tree and forest improvement through the application of principles of plant genetics. The September issue shows the tremendous progress that American forestry has made in this field in a few short years. The JOURNAL OF FORESTRY should be complimented on their continued efforts to promote progress in forestry.

Sincerely yours,

L. S. MINCKLER,
Silviculturist,
Central States Forest Expt. Sta.

C. L. Graham (1895-1954)

Clifford L. Graham, 60, supervisor of the White Mountain National Forest, Laconia, N. H. died September 26.

Born in Minneapolis, Mr. Graham studied forestry at the University of New Hampshire, but left before graduating in order to serve in World War I. Subsequently, he studied one year at the Yale School of Forestry. In 1936 the University of New Hampshire awarded him the B. S. degree.

Entering the U. S. Forest Service in 1921 on the White Mountain National Forest he rose to be assistant supervisor, served briefly as logging engineer in the Washington office, as assistant supervisor of the Pisgah in North Carolina, and as supervisor of the Unaka in Tennessee and the Cumberland in Kentucky.

In 1936 he was transferred back to the White Mountain National Forest where he served continuously until his recent death.

Mr. Graham was a Member of the Society of American Foresters, having joined in 1926.

F. I. Rockwell (1882-1954)

Frank I. Rockwell of Minneapolis was killed in an automobile accident during the past summer.

Born in Minneapolis December 28, 1882 Mr. Rockwell received the B.S.F. degree from the University of Minnesota in 1906. For the next decade he was with the U. S. Forest Service in the West, then spent four years in extension work in Idaho, followed by six years with a lumber company in Oregon, and six years as a farm supervisor in North Dakota.

During the period 1936-1945 Mr. Rockwell was state extension forester in South Dakota, and in the latter year was appointed state forester in which position he served three years. In 1948 he engaged in consulting forestry and landscape work in North Dakota, subsequently transferring his business to Minneapolis.

He first joined the Society of American Foresters in 1911.

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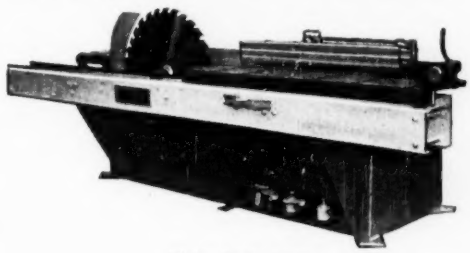

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Membership Applications and Advancements

Proposals for admission, advancement, and reinstatement received in the Society office during the month of October are listed below.

Action on the eligibility of those proposed for membership as listed below will be taken by the Council as of January 1, 1955. Communications from voting members regarding the membership eligibility of these persons should be received in the Society office prior to that date.

Allegheny Section

Student Grade

PENNSYLVANIA STATE UNIVERSITY

Balmer, H. E.
Blankenbeker, R. C.
Boyson, W. K.
Foster, R. A.
Melvin, N. D.
Schmertz, E. A.

WEST VIRGINIA UNIVERSITY

Cassell, G. R.
Kessel, L. H.
Rogers, B. B.

Member Grade

Shannon, R. B., Consulting Forester, R. B. Shannon & Associates, Kittanning, Pa.; Pa. State, B.S.F., 1948; Univ. of Vt., M.S.F., 1950. (Junior, 1948).

Appalachian Section

Student Grade

DUKE UNIVERSITY

Heeren, R. D.

NORTH CAROLINA STATE COLLEGE

Barr, B. D.
Beal, R. H.
Brooks, M. T.
Calderon, D. S.
Caldwell, H. T.
Carson, P. B.
Chapman, J. F.
Dozier, W. B.
Graves, W. L.
Harrell, K. T.
Hood, C. A.
Horton, D. W.
Kilian, L. A.
Leinbach, G. N.
Martin, A. L.
Miller, R. J.
Perry, J. U.
Sluder, E. R.
Spencer, W. G.
Webb, J. E.

Junior Grade

Evans, J. E., Cartographer, U. S. Geological Survey, Manassas, Va.; L.P.I., B.S.F., 1950.

Foster, C. R., Timber Estimator, Keedwell & Elliott, Emporia, Va.; Univ. of Maine, B.S.F., 1952.

Thrash, T. L., 111 Acton Circle, Asheville, N. C.; N. C. State, B.S.F., 1954 (Student, 1952).

Member Grade

Lively, C. B., Woodland Conservationist, Soil Cons. Service, Linville, Va.; Wash. State, B.S., (Forestry), 1932. Reinstatement.

Affiliate Grade

Leader, M. W., Asst. Forest Mgr., Koppers Co., Inc., Summerville, S. C.; Mich. College of Mining & Tech., B.S., (Forestry), 1952.

Central Rocky Mountain Section

Junior Grade

Ford, R. E., Ext. Forester, Colo. A & M, Fort Collins, Colo. Reinstatement.

Central States

Student Grade

MICHIGAN STATE COLLEGE

Andersen, D. W.
Bailey, J. C.
Benjamin, R. O.
Besonen, R. R.
Best, J. H.
Brown, B. G.
Dean, R. E.
Freydl, R. B.
Fry, K.
Goehring, H. D.
Herrick, H. F.
Herring, H. G.
Hynes, J. P.
Kuester, F. R.
Mattes, W. M.
McElroy, E. B.
Norton, G. N.
Poppy, R. E.
Quinkert, A. K.
Skau, C. M.
Spurr, H. W.
Stein, C. P.
Strohmer, J. V.
Stumbo, D. A.
Thomas, S. G.
Tikka, R. L.

UNIVERSITY OF MICHIGAN

Aughey, W. H.
Black, P. E.
Brock, S. M.
Penny, W. R.
Truesdell, P. S.
Weisz, A. E.

PURDUE UNIVERSITY

Barnacastle, R. C.
Bickel, D. R.
Killian, W. W.
Kister, H. B.
Kodrich, M. R.
Koenig, R. W.
Macko, B. A.
McCuddy, C. A.
Miller, R. E.
Pierson, G. P.
Pryor, R. L.
Skrip, R. M.
Smith, R. N.
Thomas, J. E.

Junior Grade

Ball, J. W., Ranger, State of Ohio, Logan, Ohio; Purdue, B.S.F., 1947.

Columbia River Section

Student Grade

OREGON STATE COLLEGE

Morrison, L. D.
Smith, P. C.
Winjum, J. K.

Junior Grade

Hunt, J., Pac. N.W. Forest & Rge. Expt. Sta., Portland, Ore.; Univ. of Wash., B.S.F., 1949; M.S., 1951; State Univ. of N. Y., Ph.D., 1954.

Kaiser, J. R., Forester, U.S.F.S., Maupin, Ore.; Univ. of Minn., B.S.F., 1954. (Student, 1953).

Affiliate Grade

Coldiron, H. J., Owner, Brownie Coldiron Logging Co., Powers, Ore.

Gulf States Section

Junior Grade

Aycock, O. E., Lisbon, La.; L.P.I., B.S.F., 1954.

Cardwell, C. K., Asst. Land Bank Appraiser, Farm Credit Adm., Collins, Miss.; L.P.I., B.S.F., 1952.

Shatford, J. S., Area Forester, Miss. Forestry Comm., Natchez, Miss.; L.P.I., B.S.F., 1954.

White, L. B., Asst. Dist. Forester, La. Forestry Comm., Olla, La.; L.S.U., B.S.F., 1950.

Williamson, B. C., Forester, T. L. James Co., Covington, La.; L.P.I., B.S.F., 1950.

Affiliate Grade

Keen, H. W., Forester, L. N. Dantzler Lbr. Co., Perkinston, Miss.; Okla. A & M, B.S.,

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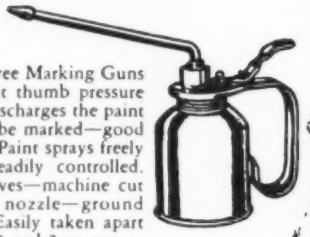

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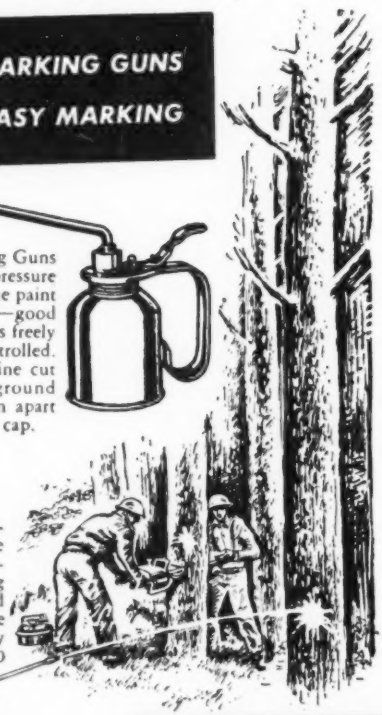

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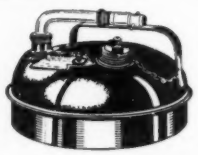

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Inland Empire Section

Junior Grade

Duvendack, G. H., Forest Supv., St. Joe Natl. Forest, St. Maries, Idaho, (Affiliate, 1951).
Swift, B. A., Forestry Aide, U.S.F.S., Pierce, Idaho; Mich. State, B.S.F., 1951.

Intermountain Section

Student Grade

UTAH STATE AGRICULTURAL COLLEGE

Bonnell, R. E. M.

New England Section

Student Grade

UNIVERSITY OF MAINE

Fiske, R. B. — McCormack, M. L.
Funking, D. L. — Weatherbee, R. L.

UNIVERSITY OF MASSACHUSETTS

Baker, R. V. — Natale, P. R.
MacNeill, R. L. — Sisterhenm, G. H.

YALE UNIVERSITY

Hilse, A. D.

Junior Grade

Fordham, R. E., Asst. Prof., Univ. of Vt., Burlington, Vt.; State Univ. of N. Y., B.S.F., 1950; M.F., 1951.

New York Section

Student Grade

STATE UNIVERSITY OF NEW YORK

Hamilton, P. C. — Murphy, R. F.
Lawton, D. P. — Watson, G. E.
Meyer, D.

Junior Grade

Wylie, A. E., Asst. Prof., State Univ. of N. Y., Syracuse, N. Y.; Colo. A & M, B.S.F., 1946; M.F., 1947; State Univ. of N. Y., Ph.D., 1950.

Member Grade

Bradford, H. N., Box 27, Hermon, New York; State Univ. of N. Y., B.S.F., 1934. Reinstatement.

Affiliate Grade

Fournier, R. L., Dist. Ranger, N. Y., State Cons. Dept., Cortland, N. Y.

Northern California Section

Affiliate Grade

Fox, E. W., Asst. State Forest Ranger, Calif. Div. of Forestry, Pine Grove, Calif.

Ozark Section

Student Grade

UNIVERSITY OF MISSOURI

Coates, J. — Woerheide, J. E.
Grey, G. W. — Wolf, H. L.
Lamar, A. J. — Wood, G. W.
Rapp, R. D.

Member Grade

Bode, I. T., Director, Missouri Cons. Comm., Jefferson City, Mo.; Iowa State, B.S.F., 1915; M.S., 1920. Reinstatement.

Puget Sound Section

Student Grade

UNIVERSITY OF WASHINGTON

Abrahamson, D. P. — Johnson, P.
Blanchard, J. D. — Lohr, J. R.
Chambers, B. P. — Rotter, E. A.
Grobey, J. H. — Smith, E. E.
Haase, J. A. — Wilson, G. C.

Junior Grade

Begalka, W., Asst. Forester, Ketchikan Pulp Co., Ketchikan, Alaska; Colo. A & M, B.S.F., 1951.
Nellist, W. C., Thr. Evaluation Eng., United States Plywood Corp., Mercer Island, Washington; Univ. of Wash., B.S.F., 1949.

Southeastern Section

Student Grade

ALABAMA POLYTECHNIC INSTITUTE

Arther, B. J. — Haley, J. E.
Baxter, J. D. — Howell, H. D.
Beckett, B. J. — Nash, R. F.
Brill, R. W. — Pitts, T. L.
Chastain, G. A. — Savage, W. H.
Darby, E. W. — Smith, C. D.
Ferris, D. J. — Spangler, M. L.
Goodrick, F. E. — Webb, C. N.
Green, H. K. — Weldy, W. E.

UNIVERSITY OF GEORGIA

Bentley, C. F. — Henry, G. W.
Carswell, S. G. — Jones, F. K.
Dumbroff, E. B. — Jones, W. M.
Freyer, D. C. — Mohla, D. G.
Harley, C. L. — Shoptaw, J. H.

Junior Grade

Filkins, E. E., Forester, U.S.F.S., Clayton, Ga.; Univ. of Minn., B.S.F., 1953.
Seymour, Z. L., Asst. Dist. Forester, Ga. Forestry Comm., Gainesville, Ga.; Univ. of Ga., B.S.F., 1948. Reinstatement.
Stone, W. N., Dist. Forester, Ga. Forestry Comm., Statesboro, Ga.; Univ. of Ga., B.S.F., 1949.
Thompson, W. B., Asst. Forester, Gulf States Paper Co., Tuscaloosa, Ala.; L.P.I., B.S.F., 1952.
Wooten, R. F., Woodlands Div., International Paper Co., Homerville, Ga.; Univ. of Ga., B.S.F., 1951 Reinstatement.

Upper Mississippi Valley Section

Student Grade

IOWA STATE COLLEGE

Herrick, O. W. — Peterson, R. E.
Keesey, J. C.

UNIVERSITY OF MINNESOTA

Lundgren, J. W. — Zelle, M. J.

Washington Section

Associate Grade

Storey, H. C., Chief, Div. of Forest Influences, U.S.F.S., Washington, D. C.; Stanford Univ., A.B., (Geology), 1932.

Wisconsin-Michigan Section

Junior Grade

Ward, J. C., Forestry Aide, U.S.F.S., Ann Arbor, Mich.; Univ. of Mich., B.S.F., 1953.
Zimmerman, E. W., Forester, U.S.F.S., Milwaukee, Wisconsin; Iowa State, B.S.F., 1931. Reinstatement.

Member Grade

Godman, R. M., Forester, Lake States Forest Expt. Sta., Marquette, Mich.; Univ. of Mich., B.S.F., 1943. (Junior, 1947).

Affiliate Grade

Smith, W. L., Real Property Asst., U. S. Indian Service, Ashland, Wis.

Foreign

Junior Grade

Gryczan, E. J., Hq. Co. 3rd Bn. 350th Inf., A.P.O. 541, N. Y., N. Y.; Montana State, B.S.F., 1952.

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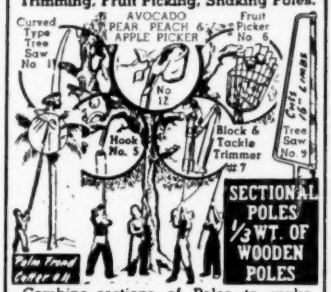
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Box G, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, 35, B.S.F., Univ. of Maine. Married, no children. Navy veteran; Photo interpretation officer, recently released from recall to active duty, training and experience in photo interpretation and photogrammetry. Past experience in timber cruising, scaling, grading, selling, and sawmill operations. Desire forestry position with private or government organization, preferably in the Northeast.
Box J, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, 24, B.S.F. Univ. of California, 1952. Single. Korean veteran, recently honorably separated from Army. Experience: Fire control work with U. S. Forest Service and California Division of Forestry. Desire position West Coast or Pacific Northwest. Eager to accept field work or work in a trainee status.
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Forester, 37, B.S.F., 15 years experience with a state agency, desires a change offering fuller opportunity for abilities, in either private or public employ. Extensive experience in forest administration, timber management, fire position in college teaching, public relations, or sales control and prevention, park operation, and public relations. Excellent references.
Box L, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S.F., M.S.F., 28, married, 2 years in USN as administrative officer, experience with federal and state forest services in management and educational work. Desire position work with private industry. Excellent references.
Box M, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, 29, B.S. 1950, M.S. 1951. Married, two children. Desire position with opportunity for advancement in management or research. Three years field research in chemical brush and weed control, one year consulting forestry, two summers U. S. Forest Service fire control.
Box N, Journal of Forestry, Mills Building, Washington 6, D. C.

Forestry News

Southern Tree Improvement Conference in January

The Third Southern Conference on Forest Tree Improvement will be held in New Orleans on January 5 and 6. Persons attending the conference should make their own hotel reservations, and should make them early, because of tourist crowds at that season. A listing of tourist courts and motels may be obtained from the New Orleans Chamber of Commerce, 315 Camp St. A partial listing of hotels is as follows:

Jung Hotel, 1500 Canal St.
Lafayette Hotel, 628 St. Charles Ave.
Monteleone Hotel, 214 Royal St.
New Orleans Hotel, 1300 Canal St.
Roosevelt Hotel, 123 Baronne St.
St. Charles Hotel, 211 St. Charles Ave.

The meeting place is the Recreation Room, Dixon Hall, Newcomb College.

Chairman of the Program Committee is D. A. Anderson, College Station, Texas. The committee on Local Arrangements consists of Philip A. Briegleb and Philip C. Wakeley, both of the Southern Forest Experiment Station, and Dr. Willis A. Eggler of Newcomb College.

Natural Resources Council of America Holds Annual Meeting

The annual meeting of the Natural Resources Council of America, with which the Society of American Foresters is affiliated, was held in Washington, D. C. on October 12. New officers were elected as follows:

Chairman, Lowell Besley, American Forestry Association, succeeding Samuel H. Ordway, Jr. of the Conservation Foundation.

Vice chairman, David R. Brower of the Sierra Club, succeeding Ira N. Gabrielson of the Wildlife Management Institute.

Reelected were Secretary, C. R. Gutermuth of the North American Wildlife Foundation and, Treasurer, Harry E. Radcliffe of the American Nature Association.

On Wednesday, October 13, the members of the Natural Resources Council met with the chief of the U. S. Forest Service, discussing Forest Service programs and national forest policies.

A.F.A. to Lead Study of Land Ownership

Lowell Besley, executive director of the American Forestry Association has indicated that A.F.A. will give early attention to the study of forest land ownership which forms a part of its recently approved Program for American Forestry. The program calls for a study on both the state and national levels. The national study is proposed for a Joint Congressional Committee. A small national group will be set up by A.F.A. to outline objectives for the joint committee and to draft legislation for introduction in the next Congress looking toward creation of the Committee. A.F.A. requested the Council of State Governments to pass a resolution providing for the appointment in each state of local committees to study forest land ownership. However, no action was taken by state governors at their summer meeting and A.F.A. now proposes to set up a small national committee to review studies already made in some states, to prepare a general outline for state studies, to determine priorities among the states in which studies should be made, and to aid in selecting persons to assist in the studies. In the individual states A.F.A. will act only in an advisory capacity.

Serious Silver Fir Beetle Damage Reported in Washington

Over half a million acres of forest land in western Washington has been infested with the silver fir bark beetle, according to a recent report by R. V. Dickhaus, chairman of a committee organized to investigate the insect threat.

Focal points of greatest damage to the forests are the Mt. Baker and Day Lake areas of Skagit and Whatcom counties. First reported in 1947 by W. V. Catlow, chief forester for Puget Sound Pulp and Timber Company, its spread has been observed throughout the western area of the state. Federal, state, and private industry forest agencies are cooperating in a concerted research program to discover methods of controlling the insect spread and holding to a minimum the loss of killed timber through deterioration. These agencies include the state Land Board, U. S. Forest Service, National Park Service, state Land Office, Industrial Forestry Association, Scott Paper Company, and Weyerhaeuser Timber Company.

All forest agencies are reorienting their logging plans to hold down the loss of timber from the infestation.

Private to Industrial

Clinchfield Railroad Employs Forester

Thurman B. Martz joined the Clinchfield Railroad Company of Erwin, Tenn., in September as forester in charge of its newly created Industrial Forestry Division. He reports that work of the division will be to initiate management practices on 5,000 acres of railroad-owned forest land, assist existing forest industries, promote new forest industries, and exert leadership in the promotion of better forestry practices.

Timber Farmers Hold Meeting

The Independent Timber Farmers of America held their second annual meeting on September 25 at Minong, Wis. Nearly 50 delegates-members were in attendance representing six states. Proxies from members in ten other states were also sent. In his annual report, Charles H. Stoddard, executive director, discussed the rapid growth in membership resulting both from holding field rallies for small loggers in the northern and eastern states and from mail campaigns among individual owners and I.T.F.A.'s legislative program during 1954.

I.T.F.A. is working on a legislative program which will include many features of our farm program for individual timber farms.

Directors-at-large were elected. John L. Sprague, secretary-treasurer and Charles H. Stoddard, executive director were reappointed for another year.

106 Tree Farms Certified at One Time

The greatest number of tree farms ever to be dedicated at one time in the United States was certified at a Orofino, Idaho, ceremony in September.

U. R. Armstrong of the Western Pine Association, the certifying agency for tree farms in the 12-state Western Pine Region, presented certificates to 106 small acreage forest property owners in the Clearwater Valley to establish the new record. Most were farmers and ranchers in the area.

Education

Ohio Forestry Research has Golden Anniversary

Completion of 50 years of forest research in Ohio was the occasion for a two-day program at the Ohio Agricultural Experiment Station on October 6 and 7.

At the anniversary banquet on October 6, speakers included E. L. Demmon, president of the Society, and Director L. L. Rummell of the Ohio Station with Hon. John McSweeney, co-author of the McSweeney-McNary Act of 1928 serving as toastmaster.

In the afternoon session on October 6 visiting foresters heard a paper, "Fifty Years of Forestry in Ohio," by State Forester O. A. Alderman. Many foresters who served in the Forestry Department since 1904 were in attendance. Among this group were E. V. Jotter, L. J. Young, and F. W. Dean who conducted forest surveys during the horse and buggy days.

Others who were formerly connected with the Forestry Department and participated in the program were Scott Harry, Frank B. Notestine, A. E. Taylor, J. W. Calland, L. J. Leffelman, and R. R. Paton. At the banquet Director Rummell presented these men with certificates of appreciation in recognition of loyal service to the Experi-

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"This is a realistic and practical book for the field forester." The Timberman, Portland, Oregon, July issue.

"Any practicing forester in the United States should profit by having this work available for day-by-day use." George H. Schroeder in review in September issue of the *Journal of Forestry*.

"I think this book is a splendid addition to the Forest Management literature, and will certainly find a place in the field of forest education." Dr. A. M. Herrick, Professor of Forestry, Purdue University.

"This is the first technical book on forest management that deals with forest land use coordination in detail. . . . The author . . . believes that the field of forest education should develop the practicing forester's concept of forest management." Review in September issue of *Civic and Planning Comment*.

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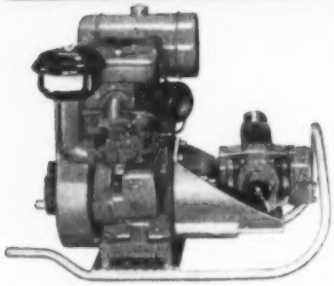

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ment Station and the State of Ohio.

Extension Forester F. W. Dean also received an inscribed desk pen set as a token of appreciation from his associates. He completes 35 years of service this year.

On the second day wagon tours were taken through the Secrest Arboretum and adjoining experimental farm woodland and wood utilization center. The speakers were Dr. J. S. Illick, dean emeritus of the New York State School of Forestry at Syracuse, and James D. Wells, assistant director, Ohio Department of Natural Resources.

Associate Director Krauss outlined the scope of the current forest research at the Station. This includes woodland management, wood utilization, forest tree improvement and strip-mine reclamation. Oliver D. Diller, chairman of the Station's Forestry Department, served as general chairman of the anniversary celebration.

Forestry Fiftieth Anniversary at Iowa State College

The fiftieth anniversary of forestry instruction at Iowa State College was celebrated at Ames on October 15 and 16.

At the opening session in Curtiss Hall, President James H. Hilton and Dean of agriculture Floyd Andre awarded two honorary degrees. Thomas R. Truax of the Forest Products Laboratory received the degree of doctor of agriculture and F. J. Poch of the U. S. Forest Service (retired) received the degree bachelor of science.

In behalf of the alumni Fred Trenk, extension forester of Wisconsin, dedicated the MacDonald Woods to Prof. G. B. MacDonald, former director of the Department of Forestry for 38 years until his retirement in 1948.

The afternoon session on October 15 was devoted to six papers on forestry education and progress in Iowa.

At the anniversary banquet, held in the Memorial Union, attended by nearly 400 alumni and friends, Prof. George B. Hartman presided. Special awards for meritorious service to forestry and conservation were presented to the following alumni: Irwin T. Bode, director of the Missouri Conservation Commission; Frederick E. Boeckh, assistant general manager of Minnesota and Ontario Paper Company; Paul M. Dunn, dean of the School of Forestry at Oregon State College; Edwin F. Heacox, managing forester for Weyerhaeuser Timber Company; DeWitt Nelson, director of the California Department of Natural Resources, who was the banquet speaker; George J. Pecaro, vice president of the Flintkote Company at Los Angeles; J. Clarence Prout, deputy commissioner of the Minnesota Department of Conservation, and Fred B. Trenk, extension forester of Wisconsin.

A. E. Schneider to Advisory Position in Korea

Arthur E. Schneider, University of Minnesota professor of forestry, has left for Korea where he will serve as chief adviser to the Seoul National University of Korea.

The University of Minnesota is working in a "sister relationship" with the Seoul university under terms of a contract between the Minnesota school and the Foreign Operations Administration.

The Minnesota school's College of Agriculture, Forestry, Home Economics and Veterinary Medicine, its Institute of Technology and School of the Medical Sciences will help the Seoul university strengthen and develop its education and research programs in agriculture, engineering, and the medical sciences.

Through the program the Seoul university will be rehabilitated, and its classrooms and laboratories equipped with modern teaching aids and laboratory equipment. The Korean university's buildings were devastated in the Communist war and its laboratories looted.

Professor Schneider will be aided by his previous experience in Korea as forestry adviser to the United States military government between 1946 and 1948. Since that time he has been on the staff of the School of Forestry of the Institute of Agriculture teaching forest management and protection and carrying on forestry research. Prior to World War II, Schneider worked for the U. S. Forest Service in the administration of national forests in many parts of the country. He is a graduate of the University of Minnesota, with advanced degrees from American University in Washington, D. C. and from the University of Washington in Seattle.

Colorado A & M Graduate to Study Forest Utilization in Finland

Merlyn M. Larson, a 1954 honor graduate of the Colorado A & M College School of Forestry and Range Management, has received a grant under the Fulbright Act to study forest

utilization and management in Finland. He will study at the University of Helsinki during the 1954-1955 academic year. He plans to give special attention to the methods of utilizing small trees as well as other utilization and management problems which are related to those found in the Rocky Mountain Region of the United States.

Larson, whose home is in Sturgis, South Dakota, is on leave from the U. S. Forest Service for this special study. He is a veteran of World War II and of service in Alaska.

XI Sigma Pi Officers Announced

Please be informed that the national officers of the Xi Sigma Pi, honorary Forestry fraternity, for the years 1954-55 are as follows: Ralph W. Hayes, forester; Bryant A. Bateman, associate forester; Robert W. McDermid, secretary-fiscal agent.

National headquarters for the fraternity during this two year period will be located at the School of Forestry, Louisiana State University, Baton Rouge 3, Louisiana.

Government

E. R. Doman to Wildlife Management Post

The appointment of Everett R. Doman of Jackson, Wyoming, as assistant to Lloyd W. Swift, chief of the Division of Wildlife Management in the Forest Service, has been announced.

Mr. Doman is a graduate of the Utah State Agricultural College, School of Forest, Range, and Wildlife Management, where he received his bachelor's degree in 1938. He conducted mule deer studies for the Utah Cooperative Wildlife Research Unit at Logan, Utah, from 1938 to 1940, and served as Project Leader on Game Research for the Utah State Fish and Game Commission from 1940 to 1943.

Doman's most recent assignment before moving to Washington was on the staff of the Teton National Forest at Jackson, Wyoming, as assistant forest supervisor.

Doman is replacing Merle A. Gee, who has served as assistant chief of the division since 1949. Gee has transferred to the Intermountain Region where he has been appointed supervisor of the Fishlake National Forest in Utah.

Region Four Completes Special Timber Planning Project

The Southwest Idaho Timber Management Study in Region 4 of the Forest Service was completed on schedule after being in progress for three and one-half years. The study had as its purpose: (1) obtain a complete timber inventory of the Boise and Payette National Forests and adjacent timbered lands as well as a portion of the Sawtooth National Forest; (2) make a study of the "outside" situation—a study concerning the economic status of the lumber industry of southwestern Idaho in regard to the availability of timber supplies as compared with industrial needs.

The timber inventory covered a gross area of 7,241,000 acres which represents nearly one-seventh of the total land area of the State of Idaho. Some 4,463,000 acres of this was classed as supporting commercial timber.

The timber inventory was based on aerial photographs used in conjunction with the latest statistical sampling procedures. A total of 1,134 randomly located plot clusters were permanently established and measured during the project. Complete type area and volume data were furnished to the forests concerned. In addition, cover type maps were prepared for each township covered.

The project was headed originally by Joel L. Frykman, now of the Division of Timber Management in Region 4. He was replaced in June 1951 by Clair R. Melvin who is presently in charge of timber management activities on the Boise National Forest. In January 1953, Mark M. Johannesen, who had been assistant to the above men, was placed in charge until the project was completed in June 1954.

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In addition to the Forest Service and Forest Survey of the Intermountain Forest and Range Experiment Station, the Boise Payette Lumber Company of Boise, Idaho, and the State of Idaho contributed to and cooperated in the entire project.

Federal Income Tax Changes in Timber Provisions

Changes in the timber provisions of the federal income tax resulting from adoption of the 1954 Internal Revenue Code are outlined below. The new federal income tax regulations which are the official Treasury interpretation of the Code and which themselves have the force of law have not yet been issued.

1. Proceeds from sales of Christmas trees are entitled to capital gains treatment (section 631-a). The term "timber" now includes evergreen trees which are more than 6 years old at the time when severed from the roots and are sold for ornamental purposes. This change over-rules a decision of the Internal Revenue Service in October 1953, which held that Christmas trees were not timber and proceeds from Christmas tree sales were ordinary income. Under the new Code, proceeds from sales of Christmas trees more than 6 years old are entitled to the same capital gains treatment as other timber.

2. New provisions in the case of timber sold under a pay-as-cut contract (sec. 631-b).

a. Change in definition of 6 months holding period. The new Code provides that date of timber disposal is deemed to be the date such timber was cut but if payment is made to the owner under the contract before the timber is cut, the owner may elect to treat date of payment as the date of disposal. This change over-rules a Tax Court decision that the date of disposal is the date of the cutting contract.

b. Change in definition of "owner." The new Code extends the definition of "owner" to include any person who owns an interest in such timber including a sub-lessor and a holder of a contract to cut timber.

3. Sections of Code have been renumbered. The former section 117-k (Gain or loss in the case of timber or coal) is now section 631 which consists of three parts, the timber provisions having been separated from those relating to coal.

631-a. Election to consider cutting as sale or exchange (formerly sec. 117-k-1).

631-b. Disposal of timber with a retained economic interest (formerly sec. 117-k-2).

631-c. Disposal of coal with a retained economic interest (formerly sec. 117-k-2).

In addition to changes in the timber provisions of the Code other changes are of interest to forest land owners. Among these are the following.

1. Soil and water conservation expenditures (sec. 175). Taxpayers engaged in the business of farming may treat expenditures for soil and water conservation in respect of land used in farming as deductible expenses rather than as capital expenditures. The amounts deductible for any taxable year shall not exceed 25 percent of the gross income derived from farming for such year but carry-over to later years is permitted. Expenditures for "soil or water conservation" means expenditures for the treatment or moving of earth and includes among other things eradication of brush and planting of windbreaks. The term "land used in farming" means land used for the production of crops, fruits or other agricultural products, or for the sustenance of livestock. The new regulations will doubtless indicate how broadly the above provisions will be interpreted by the Treasury Department.

2. Depreciation (sec. 167). More liberal depreciation deductions are permitted under the new Code than formerly. For example, one method allows approximately 40 percent of the cost of an asset to be deducted in the first quarter of its service life and two-thirds of the cost in the first half of its life. The new depreciation methods apply for the most part to property having a useful life of three years or more if acquired new after 1953.

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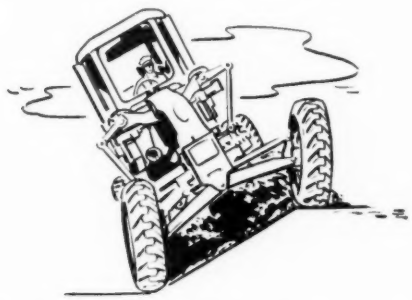

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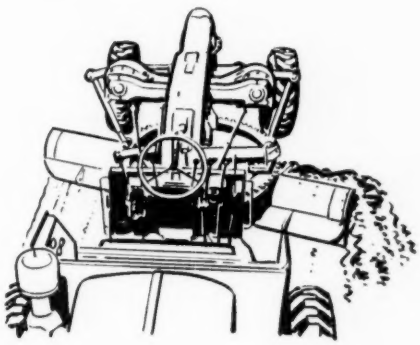

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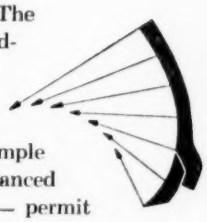

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